Faculty of Engineering Technology
The Open University of Sri Lanka

Proceedings of Faculty of Engineering Technology
Student Academic Conference 2015, OUSL

Abstracts

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Message from the Vice Chancellor

It is with great pleasure that I convey this message of felicitation to the Second Student Academic Conference of the Faculty of Engineering Technology of the Open University of Sri Lanka. When this event was inaugurated last year, it was planned that this would become an annual event in the calendar of the Faculty and I am delighted to see that this being fulfilled through successful staging of the conference this year too.

The aim of this conference is to present the work done by the undergraduate students of the Faculty of Engineering Technology to fellow students and the industry personnel. This provides the students an opportunity to showcase their innovative ideas and resourceful abilities to others.

Further, I note that the conference is organized and conducted entirely by the student community with able guidance from a few academics. This I am sure enables students to learn valuable co-curricular skills in organizing events, teamwork, communication skills etc. which will be of immense value in their professional career.

I take this opportunity to express my appreciation to the Organizing Committee of the Student Academic Conference 2015 and the staff who have contributed their time and effort to make this event a success.

I am confident that the Student Academic Conference 2015 would be an enriching and rewarding experience for all the presenters and participants.

Prof. S. A. Ariadurai

Vice Chancellor

December 11, 2015

Message from the Dean/ Engineering Technology

It is indeed a great pleasure for me to write this message to the Faculty of Engineering Technology Student Academic Conference (FETSAC) 2015. The Faculty of Engineering Technology (FET) is holding this event very successfully for the second consecutive year. The purpose of this conference is to demonstrate the findings of students' final year research projects to the industry. A vast majority of the final year undergraduate projects are related to real industry problems. This is because FET students, due to the nature of the program, are always encouraged to study while working and this fact is reflected in many of the projects being industry related. This conference provides an opportunity for these students to show their findings to a wider forum.

Today, the University-Industry partnership has become one of the important ingredients of any engineering degree programme. The link between university and the industry at the undergraduate level helps students much at their workplaces. On the other hand, the industry also benefits as the graduate who are employed by them will possess required skills expected by the industry. This whole event is organized by students of the Faculty under the guidance of academic staff. This is also a significant aspect, as the experience gained by organizing events such as this, strengthens soft skills of undergraduates.

This event comes under one of the activities planned for improving the industry relevance of the FET graduates. This programme is a part of a key activity undertaken by the Faculty under the Quality and Innovation Grant (QIG) of the Higher Education for Twenty First Century (HETC) project administrated by the University Grants Commission with World Bank funding. As this helps our students in number of ways, the Faculty is hoping to continue this as an annual event.

I take this opportunity to extend my gratitude to students who have worked hard to make this event a success. On behalf of the Faculty of Engineering Technology I take this opportunity to express my gratitude to our Vice-Chancellor who encouraged and extended fullest support to conduct this event successfully. My special thanks goes to the QIG project team of the Faculty, and the group of academics who were responsible for this conference and other related work.

I wish all the success for FETSAC-2015.

Dr. K.A.C. Udayakumar

Dean –Faculty of Engineering Technology

The Open University of Sri Lanka

December 11, 2015

Message from Chairperson -Organizing Committee (Staff)

As the chairperson of the Organizing Committee (Staff), it is a great privilege to issue this message to the second Student Academic Conference, FETSAC 2015. Empowering undergraduates to do their best is the hallmark of a good degree program. That is exactly what happens at the Student Academic Conference of the Faculty of Engineering Technology of the Open University of Sri Lanka. An academic conference has many facets. The core that everyone sees is, what is presented – i.e. research work undertaken by the undergraduates. Apart from this, to make the conference a success, many kinds of activities need to be fulfilled from an organizational perspective. Undergraduates themselves are behind virtually every aspect of this conference that has given them an exposure to many challenges. Overcoming such challenges requires commitment, dedication, team work and innovative mind. In addition they get a unique opportunity to horn their skills in these areas.

The conference also presents a unique opportunity for the students to interact with the industry, hence taking some of the work beyond their academic level to commercial level. Such commercialization could be the catalyst to encourage more students to engage in innovative work in a meaningful manner in the future.

I do appreciate the supervisors of students' research projects for extending their fullest support by encouraging students to submit abstracts and for reviewing those. I wish to thank all authors, participants, evaluation panels, academic and nonacademic staff of the Faculty of Engineering Technology and the Student Organizing Committee for their enthusiasm, commitment, dedication and hard work in making this event a success.

On behalf of the Staff Organizing Committee, I would like to pay my gratitude to Prof. S. A. Ariadurai, Vice Chancellor and Dr. K. A. C. Udayakumar, Dean/Faculty of Engineering Technology for their kind advice, support and leadership extended to us always. Special thanks goes to Dr. N. S. Senanayake for giving us continuous guidance as the staff chair of the first Student Academic Conference. I would also like to thank Eng. Nuwan Balasuriya for conducting two workshops for students on abstract writing and presentation skills. Success of a conference of this nature is owing to the collective effort of a diverse group of individuals and one of the key back office operations was the printing of all conference documents. I take this opportunity to thank staff of the OUSL Press, who have done an excellent work in meeting all the printing needs despite their all other commitments.

An academic conference requires significant financial commitment to get off the ground and I wish to acknowledge with gratitude to the Quality and Innovation Grant (QIG/R2/W2/OUSL/B Eng. Technology) World Bank funded Higher Education for Twenty First Century Project for providing generous sponsorship to make this event a reality.

Eng. (Mrs.) H. Pasqual
Chairperson,
Organizing Committee (staff) – FETSAC 2015
December 11, 2015

Message from Chairperson - Organizing Committee (Students)

It is a great pleasure for me to send this message on behalf of the student Organizing Committee of FETSAC 2015. FETSAC 2015 is the second student academic conference organized by the Faculty of Engineering Technology.

The main objective of FETSAC is to provide an opportunity for the students of Faculty of Engineering Technology to present and demonstrate their final project findings to a larger group of industry representatives and other interested people. It enables the students to introduce their successful research project outcomes to the industry and embark on further development leading to possible commercialization so that the worthy effort will finally become beneficial to the society at large. Furthermore, FETSAC is an event which builds a platform for students to share their knowledge among themselves.

Moreover, this is a great opportunity for the students be a part in organizing the event which naturally inculcates much needed social skills and experience how the challenges are successfully tackled.

Finally, I would like to thank all my fellow colleagues who continuously engaged in various tasks to successfully stage the FETSAC 2015. I would like to specially thank the Vice Chancellor, the Dean of the Faculty of Engineering Technology, FETSAC 2015 Organizing Committee (Staff) and all the staff of the faculty and the University who spent their invaluable time to make this event a success.

A. V.V.S. Bandara
Chairperson
Organizing Committee (Students) – FETSAC 2015
December 11, 2015

Organizing Committee

Organizing committee (staff)

Mrs. H. Pasqual (Chairperson)

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Mr. D.S. Wickramasinghe

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Mr. H.D.N.S. Priyankara

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Content

Abstract No: AE201

Study of the Effect of Dipping Solution and Planting Method on Germination of Sugarcane (*Saccharum officinarum*) Variety CO 775

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The per capita consumption of sugar in Sri Lanka is 30Kg and Sri Lankans consume 550,000 tons of sugar annually. However, only 7% of the annual requirement produced locally and the government spends around 20billion rupees to import sugar annually. Hence, there is a big potential for the cultivation of sugarcane (*Saccharum officinarum)* locally. One of the major problems faced by the cane farmers is lower germination rate of seed cane. Yet there are some farmers who get relatively higher germination rates when the seed canes were dipped in solutions such as fungicides, urea and lime, just before planting and also by using different planting methods. Therefore, the present study was carried out to investigate the effect of dipping solutions and planting methods on the germination of seed cane. The experiment was carried out in the field that belongs to Lanka Sugar company, Sevanagala during 2015 Yala season. Eight dipping solutions, water (control) – D1, fungicide solution (Bavistin 1kg + 100 liters of water) – D2, urea solution (1kg urea + 100 liters of water) – D3, lime solution (1kg lime + 100 liters of water) - D4, fungicide + urea solution (1:1) – D5, fungicide + lime solution (1:1) – D6, urea + lime solution (1:1) – D7, and fungicide + urea + lime (1:1:1) – D8 were used to treat the seed cane just before the planting. Treated seed canes were established in the field by using three planting methods; space planting – P1, end to end planting –P2 and one and half method –P3. The experiment was an 8 x 3 factorial with treatments arranged in a randomized complete block design (RCBD) with three replicates. Number of germinated buds was counted from 2 weeks after planting until plants were 6 weeks old. The results showed that seed cane germination is not significantly affected by the method of planting. However, type of dipping solution significantly affects the germination and the interaction between planting method and dipping solution was also statistically significant. The treatment consisting of fungicide, lime and urea at the ratio of 1:1:1 along with space method of planting, which showed the highest germination, can be recommended as the best combination of treatment for seed cane to achieve higher germination.

Supervisor/s:Mr. P. K. J. De Mel and Mr. H.M.S. Samaraweera

Abstract No: AE202

Cloning and Expression of Thermostable Alpha Amylase in *Pichia pastoris* for Industrial Purposes

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Production of industrial enzymes has been one of the most successful industries worldwide. Alpha Amylase (E.C.3.2.1.1), is a hydrolase type enzyme which aids in the breakdown of starch into maltose. Thermo-stable α-amylases have many commercial applications in starch processing, brewing and sugar production and in detergent manufacturing processes. Although Sri Lanka uses 200 billion rupees worth thermo-stable alpha amylase annually, it is not locally produced, and total enzyme requirement is imported. Even though *Geobacillus stearothermophilus* bacteria produce thermo-stable alpha amylase enzyme, it is not an efficient producer of this enzyme because of the low yield. Therefore, production of α-amylase as a recombinant protein is a good solution to improve the yield of the enzyme to the level required in the industry. The methylotrophic yeast Pichia pastoriesis is used as the organism for the high level production of recombinant proteins. Therefore, present work was carried out to clone thermo-stable alpha amylase gene from *Geobacillus stearothermophillus* and clone into highly efficient protein expression system Pichiapastoris. Genomic DNA was extracted from *Geobacillus stearothermophilus* by, a low cost method developed in the laboratory. Thermo-stable α-amylase gene was amplified by gene specific primers and expected size band was observed (1,670 bp) on an Aagarose gel. Amplified product was purified and cloned into pGEM®-T Easyvector (pGEM®-TEasy-Amy). Recombinants were screened by rapid screening method, colony PCR and sequencing for confirmation. Then attempts were made to clone thermo-stableα-amylase gene into pPIC9 expression vector. Currently work is underway to screening of recombinants by rapid screening method.

This work was supported by grant number TG 14/95 from Sri Lanka Treasury

Supervisor/s:W.W.P Rodrigo, H. H. K. Achala, A. G. B. Aruggoda

Abstract No: AE203

Heavy Metal Concentration in Rice Grains of Anuradhapura District

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The main threats to human health from heavy metals are associated with exposure to cadmium and arsenic. Although several adverse health effects of heavy metals have been known for a long time, exposure to heavy metals continues, and is even increasing in some parts of the Anuradhapura district, in particular in less developed rural areas, though emissions have declined in most developed areas in Sri Lanka. People may be exposed to potentially harmful chemical, physical and biological agents in air, food, water or soil. However, exposure does not result only from the presence of a harmful agent in the environment. The main objective of the study was to determine the levels of cadmium and arsenic concentrations in the rice grains and soil samples. The levels of these heavy metals (Cd and As) were compared with those of WHO/FAO recommended values. Rice grains and soil samples were collected from the various locations where the highly contaminated by the heavy metals. The results indicated that Cd and As concentrations of rice and soil samples were excessive to maximum levels in Anuradhapura district. Total rice Cd and As concentration in the studied areas investigated average form 0.02 ppm – 0.12 ppm and 0.03 ppm - 0.40 ppm respectively. Over 43% and 47% rice grain samples collected contained Cd and As at concentration, exceeding the CODEX committee on Food Additives and Contaminants.

Supervisor/s: Prof. C. S. De Silva, Dr. B. A. Karunaratne and Dr. R. Edirisinghe

Abstract No: AE204

Development of Masbdda *(Gymnema sylvestre*) and Stevia (*Stevia rabanica*) Enriched Herbal Biscuits

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Diabetes mellitus is a growing health concern worldwide and the prevalence of diabetes is projected to rise from 285 million in 2010 to 438 million in 2030. Herbal plants such as Masbedda (*Gymnema sylvestre*) and Stevia (*Stevia rabanica*) which possess hypoglycemic properties can be used as medicine to control diabetics. Masbedda containing Gymnemic acid is mainly responsible to repair beta cells of the pancreases .Thereby induce secretion of insulin to control type II diabetics. In addition, the Gymnemic acids fill the receptor locations in the absorptive external layers of the intestine, thereby preventing the absorption of sugar molecules by the intestine. However, these herbal plants have rarely been incorporated in processed foods. The objective of this study is to develop herbal biscuits incorporating Masbadda pieces and Stevia powder. Herbal biscuit was developed with different ratios of rice flour, wheat flour, food flavor ingredients, Masbadda leaves and Stevia powder. Sensory analysis using 25 untrained panelists was performed to select the best combinations. The selected best ratio herbal biscuit was further developed and compared with the commercial spicy biscuit. Sensory evaluation results showed that there is no significant difference ($p>0.05$) on herbal biscuit with 60%, rice, 16% wheat flour, 18% spicy flavor ingredients with 4% Masbadda leaf pieces and 2% Stevie powder biscuit with commercial spicy cracker. Therefore, herbal biscuit will have similar consumer acceptance at the market. It has recommended Masbedda leaf 8 to 12 g per day serving to achieve health benefit for a diabetic patient to reduce blood glucose level. The developed one herbal biscuit weighing 5 g containing 0.8 g of Masbedda leaves, therefore 10 biscuits are recommended to eat per day to achieve the same health benefit.

Supervisor: Dr. N. S. Weerakkody

Abstract No: AE205

Identification of Morphological Characteristics of Exotic Hybrid Varieties of Luffa (*Luffa Acutangula*)

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Luffa (*Luffa acutangula*) is a tropical and sub-tropical vegetable that belongs to family cucurbitaceae. Luffa was originated India and now it is one of the very commonly grown low country vegetable in Sri Lanka. However, the existing varieties including the hybrid variety, *Naga* are susceptible to pests and diseases and potential yield can never be achieved by the farmers. This study was conducted to evaluate 14 exotic hybrid varieties and compare the yield performance with DOA recommended variety *LA33* and existing hybrid *Naga.* The experiment was conducted at Regional Agricultural Research Center, Makandura during 2015 Yala season. The treatments were arranged in a randomized complete block design (RCBD) with three replicates. Days to flower initiation, fruit quality parameters, yield parameters and incidence of pest and diseases and final yield were recorded. The highest yield was observed in varieties *Mayuri* and *Deepika* and yields of these two varieties were significantly different from the DOA recommended variety (LA33) and the existing hybrid (Naga). These two varieties also showed a better resistance to viruses and powdery mildew. This study concludes that hybrid varies Mayuri and Deepika can be selected for further investigations.

Supervisor/s: S. M. Kumari and S. Thrikawala

Abstract No: AE206

Technology Development of Minimally Processed Mung Bean Sprouts

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The mung bean (*Vigna radiata* (L) Wilczek) is one of the most important grain legumes in Asia. Germination of mung bean seeds for human consumption is a well-known process which has been widely used throughout the centuries. Nowadays, the sprouted seeds known as bean sprouts have gained popularity in the world as a healthy food because of higher protein content (3.2g /100g). The production of sprouts from mung beans is a simple germination process that requires neither sunlight nor soil, and there is no seasonal impact. However, the availability of this nutritious product in the local supermarket is limited due to lack of proper technology for extended shelf life. Therefore, the objectives of this study were to select the best soaking time and proper sprouting method to produce mung bean sprout and to select suitable packaging material for minimally processed mung bean sprout. The experiment was conducted in two stages. Firstly, three levels of soaking time 6, 8 and 12 hour, were evaluated by measuring the sprout length and other physiological parameters. Secondly, sprouts selected from the best soaking time were subjected to three sprouting methods such as sprouting in bottles, sprouting on wet paper towels and sprouting on muslin cloth and length of the sprouts was recorded. Four different packaging materials were used to store 20 mg sprouts for 10 days and Co_2 level of each pack was measured using gas chromatography. The longest sprout length, 70.2 ± 1.8 mm, when the sprouts were soaked for 12 hours and it was significantly different from other two soaking intervals. However, there were emerged roots at second day in 12 hours soaked sprouts. Therefore, the best appearance of bean sprouts without roots were observed with 8 hour soaking time and was selected as the best soaking duration. The result of sprouting method showed significance difference among three sprouting methods. Bean sprouts with wet paper towels showed significantly highest ($p<0.05$) length, 54.2 ± 0.7 mm compared to the other methods. This may be due to the creation of suitable micro environment with optimum moisture content for proper growth for mung bean sprout. Poly ethylene bag was selected as proper packaging material as 10-15% Co_2 level was remain inside the package during 10 day storage period. This study concluded that optimum soaking duration, sprouting method and packaging material to store and extend the shelf life of mung bean sprouts.

Supervisor/s : Dr. Nimsha Weerakkody and Dr. Ilmi Hewajulige

ABSTRACT NO: AE207

Effect of Rice Processing Method on Removal of Heavy Metals in Selected Rice Varieties

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Rice is the staple food of Sri Lankans along with many Asian countries such as China, Japan, and Korea. Many researchers have reported that the presence of trace elements such as As, Cd, Pb, Hg, and the other elements in rice grains which could cause health hazardous. It has also been found that most of these heavy metals are present in the rice bran. This study was aimed to find out percentage of heavy metals in rice varieties and the effect of milling percentage for removing heavy metals in rice. Content of B, V, Co, Ni, Cu, As, Se, Cd, and Hg were tested in four varieties of rice namely BG 300, BG 358, BG 360, and *Suwandel* at five different milling percentages of 0%, 25%, 50%, 75%, and 100%. The rice samples were collected from Kobeigane AG division of Kurunegala District. Inductively coupled plasma mass spectrometry was used to assess the heavy metals. According to the results of the experiment Arsenic content of four varieties varied from 10-12 µg/kg which is far below the minimum standard level 50 PPb recommended by the FAO. Ni, B, V, Cr, Co, Cu content were less than 90 µg/kg which are also less than the recommended minimum standard levels. Among four verities of *Suwandel* showed the lowest levels of heavy metals compared to other three varieties. However, there is no significant difference observed on removal of heavy metals for milling percentage compared with the control. *Suwandel* which is a traditional paddy variety and which absorbs lowest heavy metals can be identified as the safest variety.

Supervisor/s: Dr. N. S. Weerakkody , Dr. G. A. W. Wijesekara , C. Magamage

ABSTRACT NO: AE208

A Cost Effective Mixture for Rearing Earthworms (*Eisenia fetida*) for Local Farmers

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Eisenia fetida is the most utilized worm species in worm composting and organic gardening. However, population of this important species is gradually decreasing in agricultural fields due to land degradation and excess usage of pesticides and inorganic fertilizers. Moreover, the commercial availability of this species in Sri Lanka is limited. This research attempted to develop a cost effective earthworm rearing method for farmers. The research was conducted at the Department of Zoology, Faculty of Science, and University of Colombo. Nine low cost easily available materials i.e. straw, gliricidia leaves, kitchen waste, market refuse, poultry manure (with bedding material), cow dung, coir dust, garden refuse, and dried debris mixed with top soil were used along with top soil alone (as the control) as treatments and treatments were arranged in a Completely Randomized Design(CRD) with four replicates. Each treatment used two juvenile earthworms. Number of worms, length, weight, survival rate of earthworms, pH and N content of each mixture were recorded once a month. In addition, number of days taken for the clitellum to be appeared, colour change of the clitellum, and first hatchling were also recorded. Results showed a significant difference between the treatments for weight, length, number of days taken for the clitellum to be appeared, and number of earthworms. The most cost effective treatment for population increase was the medium consisting of top soil and cow dung. In contrast, the fastest clitellum appearance was observed in the medium consisting of top soil and straw. The lowest growth was recorded in medias where top soil was solely used and when it was mixed with poultry manure and coir dust. This study concludes that the mixture consisting of top soil and cow dung is the best medium for rearing earthworm. This research implies that farmers could rear earthworms in easily available cost effective mixtures and these earthworms can be added to the soil to enhance the population of earthworms in agricultural fields. These farmers may also be able to act as a supplier of earthworms.

Supervisor/s: Dr. D. Wickramasinghe and Dr. S. Thrikawala

ABSTRACT NO: AE209

Effects of Growing Substrate and Fertilizer Mixtures of Potted Queen Palm (*Livistonia rotundifolia*)

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Queen palm (Livistonia rotundifolia) plays a major role in the ornamental plant industry in Sri Lanka. It is an ornamental palm with tall, smooth, solitary trunk and a crown of divided fan shaped leaves. It has a high demand, both as a cut foliage and a potted plant in the local as well as in foreign markets. Since top soils are not readily available and with the increasing demand soilless mixtures gain momentum in the floriculture industry today. However, soilless mixtures lack reserves of nutrients and therefore regular fertilizer supplementation to these mixtures is vital for the production of quality plants. Therefore this experiment endeavor to identify suitable substrate and fertilizer mixtures in different growth stages of queen palm. Three potting media i.e. raw coir dust (M1), mushroom treated coir dust (M2), calcium nitrate treated coir dust (M3) and three commercially available fertilizer mixtures i.e. *Osmocote* (F1), *YaraMila* (F2), *Vermicompost* (F3) were used as treatments in this study. The study was Completely Randomized Design (CRD) with three replicates and the two factors—medium and fertilizer mixtures—were arranged as a 3x3 factorial experiment. Plant height, weight and number of leaves as growth parameters along with p^H, electrical conductivity, total available nitrogen, available potassium and phosphorus of the media were measured as physiochemical parameters. According the findings of this experiment significant differences were found among the potting mixtures on commercially vital growth parameters. The results revealed that the mushroom treated coir dust is the most effective media to grow queen palm in terms of plant height, growth rate in seedling. Furthermore the EC has increased with time in mushroom treated coir dust this could be due to faster decomposition of organic matter and this could be the reason for favorable growth rate compare other treatments. YaraMila, and Vermicompost showed significantly good results in the seedling stage and the Osmocote significantly appeared to be the best in final marketable stage. These variations among the fertilizer mixtures could be due their nutrient realizing ability with time. Osmocote is a slow realized fertilizer therefore nutrients are realized slowly however it gives the significantly best results in the final stage. This study concludes that the mushroom treated coir dust is the most effective media for the potted queen palm and the Yara Mila, and Vermicompost operative in the seedling stage and the Osmocote gives best results in final marketable stage. Therefore mushroom treated coir with different fertilizer mixtures can be used to improve commercially vital growth characteristics in potted queen palm cultivation.

Supervisor/s: Mr. A. H. K. Balasuriya and Mr. A. Svinningen

ABSTRACT NO: AE210

Comparison of Single Nodal Cuttings of Black Pepper (*Pipper nigrum L.*) obtained from Rapid Multiplication Method

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One of the major restraints for cultivation of black pepper (*Piper nigrum* L.) is mass scale production of planting materials. Rapid multiplication methods can be used to cater this demand. This experiment were designed to compare the single nodal cuttings of black pepper which were obtained from six different rapid multiplication methods namely Bamboo, Heap, Heap with Saw dust, Heap with straw and Polythene tube. Selected experimental design is completely randomized design (CRD) and each treatment was replicated 50 times. Number of nodes, intermodal length, length of wine and the survival rate of cuttings were recorded after 6 weeks of planting and at two week intervals subsequently. There was no significant difference between the survival percentages among treatments. The maximum mean length of vine was observed in Heap method. Number of nodes and Inter nodal length were not significantly different among the treatments. Significantly inferior results were found in Heap + Sawdust method in terms of number of leaves, no of nodes and the girth of vine. Since those parameters reflect the growth vigor of the vine this could be disadvantage. Therefore other than the Heap + Sawdust method all other treatments can be used as Rapid multiplication method for single nodal cuttings of black pepper. Utilization of materials which are used for all other treatments that can be used for rapid multiplication techniques, according to their availability in the surrounding environment and cost.

Supervisor/s: G. A. G. Kavindi and A. H. K. Balasooriya

ABSTRACT NO: AE211

Evaluation of the Impact of Organic Manure as a Substitution to Inorganic Fertilizers on Growth and Yield of Rice Plants (Bg 94 - I)

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A judicious integration of inorganic fertilizers with compost may help to improve crop yield and soil productivity. A field experiment was planned at Rice Research Station, Dept. of Agriculture, Sammanthurai involving the use of NPK fertilizers alone and in combination with compost to evaluate the effects of the substitution of inorganic fertilizers with organic fertilizer on yield and yield attributes during 2015. Five treatments comprising of T_1 : Compost (water grass, cow dung, Gliricidia leaves, charcoal and other green manure and animal wastages) @ 1000 kg $acre^{-1}$, T_2 : NPK @ 90 – 22 – 24 kg N, P_2O_5 and K_2O $acre^{-1}$, T_3 : 50% of Compost @ 500 kg $acre^{-1}$ and 50% of NPK @ 45 – 11 – 12 kg N, P_2O_5 and K_2O $acre^{-1}$, T_4 : 25% of Compost @ 250 kg $acre^{-1}$ and 75% of NPK @ 67.5 – 16.5 – 18 kg N, P_2O_5 and K_2O $acre^{-1}$, T_5 : Control (no inorganic fertilizer and organic manures) were arranged using randomized complete block design (RCBD) with three replications. Application of NPK and its combination with compost increased the rice yield significantly. Among different combinations, 50% of Compost @ 500 kg $acre^{-1}$ and 50% of NPK @ 45 – 11 – 12 kg N, P_2O_5 and K_2O $acre^{-1}$ showed superiority in yield and yield contributing parameters followed by 25% of Compost @ 250 kg $acre^{-1}$ and 75% of NPK @ 67.5 – 16.5 – 18 kg N, P_2O_5 and K_2O $acre^{-1}$ followed by NPK @ 90 – 22 – 24 kg N, P_2O_5 and K_2O $acre^{-1}$over others. Lowest paddy yield was observed in case control. It was suggested that combined application of synthetic fertilizers and organic fertilizer proved more efficient in improving paddy yield as compared to their separate use.

Supervisor/s: Prof. (Ms.) C. S. De Silva, Mr. Y. B. Iqbal

ABSTRACT NO: AE212

Effects of Watering Intervals on Growth of Pepper (*Piper nigrum)* Nursery Plants

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Pepper (*Piper nigrum*) is one of the major spice foods, which earns a significant amount of foreign exchange to the country. It is propagated through cuttings, which are grown in nurseries. Proper watering of nursery plants is very crucial in order to get a proper planting stock at the marketing stage. Nurseries use water pumped from dug-wells or pipe-borne water, which is expensive for watering nursery plants. Since there is no proper assessment on the water requirement for pepper nursery plants, it can lead to wastage of water, increased cost of production, and affect the efficiency of production of nursery plant. The objective this study is to determine a proper irrigation interval for pepper nursery plants. The research was conducted at the plant house of sub-research station of the Department of Export Agriculture - Kundasale, during the 2015 Yala season. The experimental design was a Randomized Complete Block Design (RCBD) with three irrigation treatments and three replicates. The irrigation treatments were watering of plants at three, five, and seven day intervals. Quantities of water reduced at each irrigation interval were measured, and plants were irrigated with the deficit amounts. Plant growth parameters such as number of leaves, height of shoot, shoot dry weight, shoot fresh weight, length of the longest root, number of roots, root fresh weight, and root dry weight were measured at two week intervals. Results showed an improvement in growth parameters with lengthening the irrigation frequency. However, among parameters, root fresh weight and dry weight were only parameters significantly affected by lengthening of irrigation intervals and that was only observed between first and second irrigation intervals. This study concluded that commonly practiced irrigation interval (once in three days) can be lengthened without a significant impact on the growth of the cuttings of pepper in nurseries.

Supervisor/s: P. R. Idamekorala and S. Thrikawala

ABSTRACT NO: AE213

Impacts of further Intensification of Greenhouse Environmental Conditions on Bell Pepper (*Capsicum annum* L) Yield and Quality

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Bell pepper (*Capsicum annum* L.) is an important vegetable crop throughout the world and one of the most intensively grown greenhouse vegetables in Sri Lanka. Even though bell pepper is one of the major crops grown under controlled environmental agriculture, one of the main problems in popularizing this crop amongst farmers is the very high percentage of fruit abscission seen amongst immature fruits. Hence this research was undertaken to investigate the influence of supplementary illumination for greenhouse bell pepper to reduce the pre-mature fruit drop and to increase the quality of the yield. The experiment was conducted under glass house conditions using the bell pepper variety "Aristotle" at the Dodangolla Experimental Station of the University of Peradeniya, which is located in the Mid-country Intermediate Zone during February to July 2015 (*Yala* season). Three treatments were applied 5 weeks after transplanting (WAT); T_1 (supplementary lighting to extend day length during 5.00a.m. to 7.00a.m. and 6.00 p.m. to 8.00p.m.), T_2 (supplementary lighting under rainy/cloudy weather in between 7.00 a.m. to 5.00p.m. using LEDs (Light Emitting Diodes)) and Control (natural light). The research was laid out according to Complete Randomized Design (CRD) with three replicates per treatment.Results revealed that fruit drop in T_1 and T_2 have not significantly reduced through supplementary lighting, compared to the control. Also no significant differences were observed among the supplementary lighting treatments related to fruit drop. However fruit yield was significantly greater in T_1 (220.74 g/plant), compared to T_2 (202.37 g/plant) and T_3 (182.17 g/plant) at the first harvest. Second and third harvests were not significantly differ and this could be due to the stressful environmental conditions imposed on plants due to high temperature and low humidity levels which could hindered the natural growth of the bell pepper plants. Hence, better control of environmental conditions such as temperature, needs to be adopted to further clarify the influence of these two light treatments on reducing fruit drop and enhancing fruit quality in bell pepper.

Supervisor/s: Prof. W. A. P. Weerakkody and Dr. S. Thrikawala

ABSTRACT NO: CE201

Case study of Coastal Erosion along the Coastline of Point Pedro Area in Jaffna Peninsula

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In Jaffna Peninsula northern coastline is severely affected by the coastal erosion. In the area erosion is continuously occurring and considerable amount of costal area have been lost. The coastal erosion is causing severe social, economical and environmental impacts in the area. Because of the coastal erosion seawater penetrates into the land area through interconnected limestone cavities and reduces the ground water quality of the area and increases salinity of ground water of the area. Due to this ground water becomes unfit to drink. Sea water intrusion into the land area is one of the reasons for the ground water quality reduction in the area. Due to the sea water intrusion, drinking water problem arises in Jaffna Peninsula. Nowadays it becomes major problem of the area and there is a necessity to find immediate solution for this problem otherwise entire ground water resource of Jaffna peninsula will become unfit to drink and will cause drinking water scarcity and also cause impacts on local agriculture and economy. Point Pedro is well developed heavily populated, industrial, port city in the Vadamarachchi region. In the area land value is very high. Coastal erosion impacts in Point Pedro area will affect entire region of Vadamarachchi and Jaffna Peninsula and creates social, economical and environmental problems in the region.

Nowadays our world's population is increasing at a very high rate. Rapidly increasing world's population and its demands create lot of social, economical and environmental problems. Due to the increasing population and its demands land value is continuously increasing so there is a necessity to protect our Earth's land area from coastal erosion and other type of similar impacts. Our country is a small island nation; its land area is limited. In order to handle increasing population, its demands and related problems we must protect our limited land area from coastal erosion and other type of similar impacts.

In order to protect the coastline of Point Pedro and minimize the impacts, from the finding of our research study two suitable protection mechanisms (breakwater and gabion wall) were designed.

Supervisor: Dr. P. K. De Silva

ABSTRACT NO: CE202

A Solution to prevent Deposits of Sediments across Lunawa Outfall and Assessment of Environmental Changes

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A large variety of numerical modeling systems following different physical and numerical approaches and methods have been developed in the past decade. Further details about the sediment transport can be described by a numerical simulation, and a long-term prediction can be made at a lower cost.

The people in Lunawa lagoon, situated in Moratuwa, have been facing a huge problem due to the flooding in Lunawa lagoon. It occurs due to the deposits of sediments across the outfall of the lagoon. As a result, the outfall of the lagoon is blocked often and occur flood. It affects day to day activities of people who are living surrounding area of Lunawa lagoon. The purpose of this research is to propose a breakwater at Lunawa outfall, Moratuwa to prevent from deposits of sediment across the outfall of the lagoon. It is a long term solution to people live surrounding area of the Lunawa lagoon and it solves problems encountered at the Lunawa lagoon area nowadays.

Numerical simulation was created to represent the hydrodynamics and sediment transport patterns prevalent at the site, using MIKE21 developed by DHI. The results of the model have been compared with the field measurements to assess the reliability of the model. Even though there were many research studies carried out around the world, in the case of Sri Lanka the study area found to be novel and literature related to this is barely available.

Outfall of the Lunawa lagoon is situated in 6^{o} 47'N 79^{o} 52'E in the Western coastline of Sri Lanka. The selected study area is between latitudes 6°40' to 6°54' North and longitudes 79°48' to 79°54' East. Several Field visits were done to investigate the sediment characteristics at the Moratuwa coastal zone and previous studies were used to find input data for numerical simulation. Wave, Bathymetric and other relevant data were obtained from the Oceanography Division, NARA (National Aquatic Resources research and development Agency). After developing the numerical simulation, three scenarios were proposed with different alignments of breakwater structures and all scenarios were simulated using the developed model. The results were compared and selected the suitable alignment for the proposed breakwater.

Both coastal and lagoon environment is to be changed with construction of breakwater. Breakwater affects the hydraulic system of the relevant area and produce long term and short term impacts on maritime life. Hence the proposed breakwater was selected while minimizing the environmental changes.

Supervisor : Dr. P.K.C. De Silva

ABSTRACT NO: CE203

Identification of General Requirements of Sri Lanka Residual Soils for Improvement of the Selection Criteria of Pavement Materials

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Civil Construction work in Sri Lanka faces many problems due to inappropriate construction materials used in road pavement design. The quality of the pavement construction is achieved mainly through maintaining the required CBR levels. The criterion for CBR is not satisfied in many instances. These problems delay the projects, and waste a considerable amount of time, resources and labor.

Hence, this study was carried out to find a suitable criterion to predict CBR values with soil index properties which can be specifically applied to Sri Lankan Residual soils. The study has examined the feasibility of single linear regression analysis and multiple linear regression analysis in correlating CBR values with soil index properties. Accordingly, thirty disturbed samples from Matara-Beliatta, twenty from Kurunagala and twenty from Mihintale areas were collected and the required laboratory tests have been conducted in order to achieve the intended relationships.

Statistical software (SPPS) was employed to investigate the significance of individual independent variables. The correlation were established in the form of equations of CBR as a function of grain size parameter, Atterberg limits and compaction parameters by considering the effect of an individual soil properties as well as effect of a combination of soil properties on the CBR value. The developed correlation entailed a moderate Determination Coefficient R2 of 0.506 for Kurunagala area, 0.440 for Matara area, 0.256 for Mihintale area using single regression analysis, while multiple regression analysis generated relatively an improved Determination Coefficient 0.726 for Kurunagala area for a sample size of twenty, 0.506 for Matara area and, 0.402 for Mihintale area for a sample size of thirty and twenty respectively. Validating the developed correlation with control test results, was noted that the correlations of CBR value with soil index properties are more suitable for application in preliminary characterizing of soil sample selection, while applying for detail design or critical analysis a complete detail laboratory test should be accounted.

Supervisor : Mr. M. N. C. Smarawikrama

ABSTRACT NO: CE204

Use of Rice Husk Ash Blended Cement for Manufacturing Cement-Sand Cellular Blocks

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Cement sand cellular block is becoming a commonly used alternative material to clay bricks in Sri Lanka due to its inherent advantages. Research attention has been drawn to increase of compressive strength of cement sand cellular block and to the reduction of cost of manufacturing. In this backdrop, rice husk ash (RHA) which is a pozzolana, and contains silica can be considered to utilize for manufacturing of cement sand cellular blocks. In Ampara district, large quantities of RHA are available as a byproduct from a large thermal power plant, rice mills and brick kilns.

In this research, mixtures have been essentially prepared using four binder-sand ratios namely 1:3, 1:4, 1:5 and 1:6 and water-binder ratios namely 0.4, 0.5 and 0.6. RHA is blended with cement in percentages of 0, 5, 10, 15 and 20 by weight. One hundred and twenty cubes were cast (4x3x5x2=120) which were tested for compressive strength at 7 and 28 days. Based on the compressive strength values, 1:5 binder-sand ratio was chosen as the appropriate mix proportion to cast cellular blocks for different water-binder ratios namely 0.5 and 0.6 as per SLS 855. RHA was blended with cement in percentage of 0, 5, 10, 15 and 20 by weight and in producing cement sand cellular blocks of size 390 x 190 x 200 mm. Those samples were too tested for compressive strength and water absorption. A comparative study on chemical composition and physical properties was carried out and the experimental results were discussed. The compressive strength in 7, 14 and 28 days of cement sand cellular block for 1:5 binder-sand ratio for water-binder ratio 0.5 and 5 per cent cement replaced with RHA were 2.05 N/mm^2, 2.24 N/mm^2 and 3.37 N/mm^2 respectively. Likewise the same values for 1:6 binder-sand ratio for water-binder ratio 0.5 and 5 per cent cement replaced with RHA were 1.6 N/mm^2, 2.18 N/mm^2 and 3.24 N/mm^2respectively.

The study concluded that the compressive strength increases up to 5 per cent replacement level of RHA. When the replacement level of RHA is increased beyond this compressive strength begins to decrease and water absorption continue to increase the. Further, the study concludes that given all RHA generated in the country can be put in to use for cement replacement, the total saving to the country is approximately Rs. billion 3.0.

Supervisor : Dr D. A. R. Dolage

ABSTRACT NO: CE205

Investigation of Parallel Trusses using Circular Hollow Sections as an Alternative to Universal Beams

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In Sri Lanka, steel trusses and universal beams play a vital role in construction of small to large span industrial buildings. However, universal beams are still the most popular in industrial buildings due to their shallow construction depths, pleasing appearance and shorter construction period. Moreover, they provide more head room than conventional trusses and are versatile for a wide range of spans.

Parallel trusses can be used as an alternative to universal beams. Trusses have a top and a bottom chord member. If these chords are parallel, it is called as parallel truss. Due to the low weight of the truss, handling is much easier at the time of erection of the building than universal beams. Another advantage of the parallel truss is that they use webs of the same lengths and therefore reduce fabrication costs when used for very long spans.

The objective of this study was to evaluate the cost effectiveness of trusses fabricated with circular hollow sections (CHS) compared with universal beams. Design of the beams and corresponding alternative trusses for spans from 6 to 16m in steps of 2m were carried out in accordance with BS 5950 part 1:2000. Analysis was carried out using SAP2000 and a manual verification was done only for one span.

The analysis was based on BS 5950 part 1:2000 and demonstrated that the suitable truss geometry for the examined situation is the Warren truss, which has lower weight and fewer connections than other types such as Lattice girder, K type web etc. Connections for the truss members also were done following the same guide lines.

Results of the analysis indicated that the material cost of the universal beam is greater than that of the parallel truss fabricated using CHS. Similarly, the cost of plant machinery and tools for connecting parallel truss using CHS is less than the corresponding cost for connecting universal beam. It is also seen that the labour cost for erecting, painting and placing of the CHS parallel truss is high as it needs more time and human labour than the universal beam. However, in Sri Lanka the labour cost is significantly low compared to developed countries and therefore the higher labour cost of parallel trusses is offset by the higher material cost of universal beams.

Therefore, it can be concluded that the more economical solution is the parallel truss using circular hollow sections and also that it is a great alternative to the universal beam when used up to 14m spans. In addition, the CHS trusses also have the advantage of better aesthetics over the universal beams, which will result in a better appearance in the final outcome. The limitation on these advantages is the higher depth of the parallel truss which in turn increases the height of the building.

Supervisor: Mr. L. S. S. Wijewardena

ABSTRACT NO: CE206

Investigation of Chloride Iron Penetration Resistance and Plastic Shrinkage Cracks of Mineral Compound Mix Concrete

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Sri Lanka is an island surrounded by the Indian Ocean and has a large number of reinforced concrete (RC) structures near the coastal area. Chloride attack on these concrete structures has become a significant issue in the construction field and measures are necessary to curtail the attack of chloride ion which leads to corrosion of the reinforcing steel and a subsequent reduction in the strength, serviceability, and aesthetics of the structure and failing of the concrete structures.

Bottom ash and silica fume mineral compound mix concrete decreases the permeability of concrete and therefore it is worthwhile to investigate whether it will provide resistance against the chloride ion penetration and the presence of these mineral compounds may have any adverse effect on plastic shrinkage. Therefore, the research paper seeks to examines the chloride ion penetration resistance and shrinkage crack performance of silica fume and bottom ash mix concrete.

The physical properties of the mineral compounds namely, fineness, specific gravity and water absorption were determined. Concrete samples of grade 25 and 30 were cast according to the Design of Experiments (DOE) mix design method. Specimens with ordinary Portland cement concrete (control) and OPC replaced by silica fume at 5%, 10% and 15% by weight of cement and bottom ash at 10%,20% and 30% were cast. Chloride Ion Penetration test was carried out according to the procedure given in ASTM C-1202.Srinkage crack performance was carried out as per the standard ASTM C-1579.

It is found that the workability reduces with the increase of silica fume and bottom ash for both grade 25 and grade 30 concrete. The compressive strengths decreases with increases of silica fume content in the concrete for grade 25 and grade 30. The addition of silica fumes and bottom ash decrease the chloride ion penetration resistance for both grades of concrete. Shrinkage crack reduction ratio is found to increase with increase in silica fume and bottom ash for both grades.

Supervisor/s: Dr.(Mrs.)K. M. L. A. Udumulla, Dr. P. A. K. Karunananda

ABSTRACT NO: CE207

Alternative Filler Material for Asphalt Concrete

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Disposal of waste plastic and scrap tyres have become a serious problem as environmental pollutants released in open dumping and incinerating increases air borne toxins contributing to the Global Warming and increase of carbon dioxide emissions. Asphalt concrete, which is widely used as the wearing surface of highways could be used to encapsulate such pollutants within its mass, thus reducing the environmental impacts caused by open disposal. Therefore, this study was aimed at ascertaining the viability of partially replacing natural aggregate required as a structural filler with plastic & scrap tires in asphalt concrete production.

Out of all plastic/polymer waste materials 'Polyethylene' which is a major waste and shredded scrap tyres, were chosen as partial replacement for aggregate in asphalt concrete. To study the consistency of bitumen modified by polythene, shredded polyethylene (Passing 5 mm sieve) was added in different percentages to heated bitumen to prepare plastic-bitumen blends. Standard bitumen consistency tests were performed for different blends to ascertain the physical properties against a bitumen control sample. The shredded polyethylene and scrap tire particles (both passing 5 mm sieve) were mixed in different percentages to partially replace the fine aggregates in asphalt concrete mixes starting from 0% to 10% and from 0% to 6% respectively. The Marshall Mix design method was used to evaluate the Marshall Stability and flow values of those test specimens.

The test results indicate that the softening point increases with the addition of plastic particles to the bitumen whereas the penetration decreases. Use of waste plastic and scrap tire as a partial replacement for natural aggregate in asphalt mixes up to 6.4% and 2.4% in total weight respectively, could maintain average performance and the characteristics of this asphalt test mixture were comparable with the standard requirements. Also, the test results for modified asphalt concrete specimen indicate the stability, bonding strength and other properties that are within the acceptable range.

The direct cost comparison for the production of waste added asphalt mixture does not show any advantage. Nonetheless, by producing one ton of waste mixed modified asphalt concrete will benefits the environment by reducing 100 kg and 50 kg of carbon dioxide that would be generated by incineration of waste polyethylene and scrap tire respectively. In addition to environmental benefits, positive saving can be achieved such as mosquito vector reduction, lowering ground water contamination, reduction in waste disposal costs, etc.

Supervisor/s: Prof. T. M. Pallewatta, Eng. D. M. P. B. Thibbotuwawa

Abstract No: EC201

E – Pregnancy Care System

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Available evidence in the literature shows that the care of antenatal and fetus condition care is high in the world especially in developing countries. Maternal, child health and family planning services are provided through the well-developed health infrastructure of the Ministry of Health which has grown steadily over the past few decades in Sri Lanka. The Public Health Midwife (PHM) is the front line health worker and each PHM has a defined area consisting of a population ranging from 3000 – 6000. Through systematic home visits, the PHM provides care to pregnant women within her area. It is hard and inefficient to manually organize and analyze the data collected by PHMs.

In order to be more effective, appropriate interventions must be introduced during pregnancy to prevent or detect early risk factors that contribute to adverse maternal and infant outcomes. e– Pregnancy Care System is developed to serve this need.

This system is accessible to pregnant mothers, family members, PHMs and doctors using a personal computer or a smart phone. The system is implemented as a responsive web application using PHP, HTML, JavaScript and MYSQL. The web application allows PHMs to input the information given in pregnancy record cardand from various clinics.Pregnant mothers can have a centralized repository of their health history in their smart phone which can be access from anywhere whenever they need.

E–Pregnancy Care System proposes a hierarchical clustering method that combines multiple factors to identify clusters of pregnancy mothers with risks; thereby assist the PHMs and doctors for decision making process using the data retrieved by the captured information over a period of time. The hierarchical clustering method is implemented using Weka.

Meanwhile the e–Pregnancy Care System can be used as a monitoring tool to monitor the progress of fetus development, and to identify if any abnormalities where special intervention of PHMs and doctors are required.

Supervisor/s: Dr. (Mrs.) H. U. W. Rathnayake and Eng. (Miss.) G. S. N. Meedin

Abstract No: EC202

"Partner Finder" Matchmaking Web Portal

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According to the information gathered during literature survey, finding a suitable partner in Sri Lanka is not easy with the available software systems at the present. Even in the age of internet people are heavily depending on paper advertisements where they will only figure out certain aspects which are not in their criteria such as height, job etc.

We observed that this domain has got less focus and it can be improved to a higher level where people can be satisfied with their selections without going into a lot of troubles. After all this will be a community service for people who are looking for the perfect partners. Our approach is to provide a new experience to the Sri Lankan people using new technologies currently available.

Fuzzy logic is the Artificial Intelligence technique that is used to build the matching algorithm. We use Java open source library called JFuzzylogic as a third party tool. People can specify their preferences for the height, age, and monthly income. Then the system will calculate the compatibility rate for the specified preferences using Fuzzy Logic. Those results can be also filtered using location, religion, race etc to find out the most suitable partner.

Users can add resulted partners into their interest list to follow up later. They can also send proposal request to the partners who are in their interest list. Response of the proposal will be alerted them to notify the status of the proposal. Once the proposal is accepted they will be able to contact each other. System will always track down the status of the proposal. Once it is confirmed by both parties system will identify them as couples.

System is implemented in JSP.HTML, CSS, jquery, javascript, Restful web services are used to get the final outcome.

Supervisor: Dr. (Mrs.) H. U. W. Rathnayake

Abstract No: EC203

AQSTES – Acupressure Self Treatment Expert System

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Field of medicine has an expensive and huge knowledge body. Allopathic medicine, commonly known as western medicine,is the most famous medical tradition in the world though chemical drugs used in allopathic medicines come with lots of side effects. Even though there are other medical traditions that uses medicines that does not use artificially made chemical drugs and treatment techniques that has no or minimal side effects, those are not widely known therefore not widely used. Knowledge of these medicinal systems are often handed over from person to person and no formal body of knowledge on such systems do not exist.

Acupressure is an ancient healing art which is more than 5000 years old. Acupressure is a form of touch therapy that utilizes the principles of acupuncture and Chinese medicine. In acupressure, the same points on the body which are used as in acupuncture are used, but are stimulated with finger pressure instead of inserting needles. Acupressure is used to relieve a variety of symptoms and pain. Acupressure does not use chemical drugs, thus have no drug related side effects.

AQSTES is a rule based expert system that helps patients to use Acupressure methodology for self-treatment. This system is accessible to anyone who wants to get self-treatment without any side effects. This is a responsive web based system which can be accessed viamobile phones using PHP (Laravel), HTML, and JavaScript. This web application uses CLIPS (C Language Integrated Production system) as expert system via common gate way to communicate with PHP. Web interface gets maximum human computer interaction with 3D Human body made by webGL and Collada.

Acupressure points in human body are fixed and all human body parts are related to one unique acupressure point in human body. All treatments come with touching limp points. This knowledge is represented in CLIP rules. CLIPS common gateway gets this knowledge to the web system and patients can describe their pain points and difficulties using 3D human body.

Collada 3D human body is mapped to each and every acupressure points. The software tools webGLandcollada enhance human computer interaction. Since this is a medical tool patients must be given maximum interaction with the system to get more accurate results.

Supervisor: Dr. A. P. Madurapperuma

Abstract No: EC204

An Intelligent System to Connect Land Seekers with Land Buyers

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The concept of experience economy states that consumers are becoming more sophisticated and expect memorable experiences when purchasing goods and experiences. Advances of technology in leaps and bounds during the past few decades also have created a digitally savvy, connected populace whose world is digitally enhanced. Consumers expect an enhanced service where the physical world is enhanced through digital services.

The process of purchasing a block of land for building a house or other purposes is an important decision of many person's life and is often tedious and stressful. Currently, there are no systems that provide a digitally enhanced intelligent environment that can make the purchase of a land a pleasurable experience. A person wishing to purchase a land has to make several visits to the site before he can make a decision. This is because he/she is not able to make a preliminary evaluation about the suitability of the land using commonly available information such as the location of the land, its environment, other constructions around the land, the profile of the people living in the area, distance and easiness to travel to schools, hospitals and other important places and if the land is prone to flooding during rainy season. Due to lack of credible information sources, land seekers often have to make multiple visits and rely on multiple sources.

This project aims to solve this problem by building an intelligent system that can help a person make an initial evaluation of a land before making further investments, either financially or time-wise. The system is composed of a set of interconnected information agents that will help a prospective land seeker identify a suitable land without making any physical visits. It will save the user time and a person can make a better decision about the suitability of the land.

A prototype system was developed. The system has several agents that interact with popular social media sites to gather information. Agents communicate among themselves to collate useful information such as virtual 360 images of the land, transport information such as bus routes, background information about the neighbors of the identified land and other relevant information. A management agent will collate all the relevant information into an attractive presentation as a response to a user query. We envisage that a user is able to make an intelligent evaluation of the suitability of a land before making further commitments. Later the system will be extended to include automatic selection of suitable lands depending on user preferences.

Supervisor: Dr. A. P. Madurapperuma

Abstract No: EC205

Cost Optimization for Offset Printing Industry

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Communication is one of the core requirements for the sustainability and for the development of the human kind. Out of the many modes of communication print media has become one of the main modes for mass communication. Hence the print media has developed from scribblings in a rock to digitally printed material. At present there are many methods of printing such as offset printing, Duplo printing, 3D printing etc. Out of all these printing methods, offset printing is identified as the most cost effective printing method for large quantity. Hence there is a huge demand for streamlining all aspects of offset printing in order to cut down costs further and for efficiency improvement.

Usually the customer either provides the idea of the printing job or provides the artwork to the Printer as a soft copy. These print orders involve printing of different shapes with varying colours. Considering all these the printer has to give the most probable cost estimation within a minimum time period. The customer decision on placing the order is always based on the quality as well as on the price. The estimate can be improved by having an optimal cutting solution which is the market winning point. The project "Off Optimizer" presented in this paper address these limitations in the offset printing industry by providing an automated solution.

The optimum number of shapes that can be cut from a given paper size is presently calculated manually by experienced estimators, which is a tedious as well as a time consuming work. Efficient calculation of this work reduces the cost as well as the paper wastage. In doing so the edges of the shapes of the printing matter is transformed to an array.

Usually the softcopy of the input print matter is given in a white background. Then this print matter is converted to a web DPI (dots per inch). After the DPI converting process the system makes new images by placing the print matter in different angles such as 30^0,45^0,60^0, and 90^0. Then by considering the colour difference of the edges the system decides the maximum number of shapes that can be cut for each and every angle. At this point a human can make the decision on what is the best angle to cut the shapes or else can choose the advanced option. In the advanced option the tessellation can be created by mixing of different angles. Once the most suitable model is identified the system will calculate cost according to the given paper size.

Furthermore depending on the size of the paper, order quantity and the number of colours involved for printing, the Off Optimizer is able to suggest the most suitable type of printing machine out of the available. In addition the Off Optimizer stores the total solution for a given job so that the repeated jobs are made much easy. In future the Off Optimizer will be enabled as a web plugin so that from anywhere, the printer will be able to give the cost estimation for a given job. At present the system implementation is complete and evaluation of the system is being done.

Supervisor: Dr. (Mrs.) D. D. M. Ranasinghe

Abstract No: EC206

Design and Development of a Localization and Landmark Mapping Autonomous Robot using Robotic Operating System (ROS)

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This project directly calls to the problem state occurs when cutting grass using grass cutting machines and helps to design / develop a Localization and Landmark Mapping Autonomous Robot using Robotic Operating System (ROS) .The robot has the ability to navigate in a mapped or unmapped indoor environment according to the identified landmarks. The Beagle Bone processing board that runs the ROS software platform has the ability to get the inputs using the Light Detection and Ranging (LiDAR) sensor, process the data and outputs signals to the motor controller of the autonomous mobile robot. The LiDAR sensor sends the data to the processing board as a binary data stream. The main purpose of the design and development of this robot is to compare the accuracy of Simultaneous Localization and Mapping (SLAM) algorithms and identify the best SLAM algorithm to apply to an autonomous outdoor grass cutting robot.

For this project application of probabilistic robotics approach is used. It represents describing uncertainty using the calculus of probability theory. These probabilistic robotics algorithms represent information by probability distributions over a whole space of possible hypothesis. These probability algorithms enable to accommodate all the sources of uncertainty. SLAM algorithms are probabilistic algorithms .In SLAM algorithms these information is called particles. Some SLAM algorithms are used particles and some are not. In this project FastSLAM and tinySLAM algorithms are used and tested the accuracy of each algorithm by identifying landmarks of an environment using ROS.

For the localization and mapping of the robot ROS Navigation Stack is used because the autonomous robot is a differential wheeled robot. Navigation stack is specially designed for these types of robots. It has the ability to get all the information of the sensors attached to the robot using Transform Frames (TF) software library. This software library manages a transform tree that has information of each and every sensor information attached to the robot. Also this robot has 3D model that in real-time shows the motion and the scanned map of the environment. Real-time visualization is done using Robot Visualization (RViz) tool in the ROS. The map of the scanned environment can plot after scanning the area and test the accuracy of the map. Normally the data come from LiDAR sensor is saved in ROS bag files in binary format for further analysis.

Supervisor: Eng. C. J. Basnayake

Abstract No: EC207

Robot Development System; MATLAB Simulation Model for Robot Kinematics of 4-DOF Robot Arm

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In the industrial automation, robot arm is the most powerful tool that is used for many industrial forms such as welding, material handling, and thermal spraying, to painting and drilling. A robot arm can be any number of mechanical, programmable devices that are designed to accurately manipulate objects in a way that is similar to the human arm. The department of electrical and computer engineering, has 4 degree of freedom robot arm. But there was a significant error in the tooltip point (end effector) of the 4 DOF robot arm. To overcome this problem, the aim of this project is to develop robot kinematic model and simulate it using MATLAB.

In MATLAB, mainly used robotics system toolbox™ to develop the robotic kinematics simulation model for 4-dof robot arm. The robotics system toolbox™ provides algorithms and hardware connectivity for developing autonomous mobile robotics applications. The MATLAB graphical user interface is created to read the end effector coordinates to operate the 4 DOF robot arm. After reading these X,Y, and Z coordinate values pass to the robotic inverse kinematics model to compute the joint angles of each joint. To do this computation mainly used Denavit-Hartenberg (DH) parameter table based on the robot arm link lengths and some inbuilt functions provided by the robotics system toolbox™. The function "*DhArm_OpeningFcn*" is the main function that is used to provide DH parameters of the robot arm. In simulation model has four separate MATLAB functions for each and every link (makelink0, makelink1, makelink2, makelink3). These functions combined with the main program to compute the angels. After the computation, these joint angles pass to the MATLAB graphical user interface in order to simulate the 4 DOF robot arm visually.

That Developed simulation model GUI based on the inverse and forward kinematics that can appear a model of the arm with simulation. We can input XYZ coordinates through the GUI and get the robot arm end effect with end point actual coordinates. As an example, if the coordinates are X=-2, Y=-7, Z=10, then the actual position, given by the simulation model of the arm is X=-1.754, Y=7.036,Z=10.101.In the simulation model set the all joint angels without rounding.

Supervisor: Eng. C. J. Basnayakage

Abstract No: EC208

Feedback Control & Data Acquisition System for ROWE- type Consolidation Cell

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The ROWE-type consolidation cell is used in the Civil Engineering experiment to find soil strength. Nowadays this laboratory experiment is done manually by human interaction. Sometimes entire test duration may be continued more than a week. So the user has to record readings in an entire week in minute by minute to hour by hour. Furthermore the user has to maintain constant pressure for this experiment. So this is time consuming work. Therefore, objective of this project is to design automated data gathering mechanism and intelligent feedback control system for the experiment.

The proposed system controls the pressure in the ROWE cell by using pressure generating cylinder unit which is driven by a stepper motor and lead screw. In this case diaphragm pressure is measured by a pressure sensor and this values process by main controller using a PID algorithm. As an example, if the user wants to set the set-point pressure at 100KPa from the software interface. Then the main controller operates to bring the measured pressure value to set-point value by using pressure generating unit to maintain constant pressure in ROWE-cell. The data acquisition system captures the pressure sensor reading and records the pressure values. Finally the user can find soil strength by analyzing these recoded pressure values.

According to the test results the proposed system achieved an average error of 1% in the feedback controller and data was recorded in every 200ms intervals as a basic requirement. The proposed system introduces an easy, low time consuming, high accuracy and cost effective solution to find the soil strength by using automated control and data acquisition system.

The system works well, but there are several drawbacks found at the end of the project. Basically analog to digital (A/D) convertors used in this system have 12bit resolution, which is not enough to record the tiny pressure variation. Therefore, it affected to control mechanism and readings. Also the operational amplifier (Op-Amp) offset errors and noise affected to the signal conditioner circuits. Therefore output was fluctuating and not much stable. So off-set error correction circuits and filter circuit were required. Also basically system was developed to find the vertical consolidation only. But it can be updated to find horizontal consolidation in the future.

Supervisor: Eng. C. J. Basnayakage

Abstract No: EC209

Sign Language to Sinhala Speech Converter

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Normal community cannot understand the sign languages developed for differently abled deaf community. Due to this reason, our project is carried out to implement an interface for the normal community to understand one sign language used by the deaf community. The proposed software system is designed so that it can translate Sinhala sign language to Sinhala speech and text, using recognition and comparative techniques for each modality. Such a system enables communication with the hearing impaired when no other modality is available. This system is capable of identifying the hand gestures of Sinhala sign language real time and converting it to the text and Sinhala speech. In today's world many devices have integrated cameras or personal webcams. This system uses above facilities to capture hand gestures.

Firstly, the system gets the camera frames one by one and inserts them to gesture filtering and noise removal section. Next, the filtered gesture is sent to the comparator for translation. If that frame matches with some template, it gets the data using speech synthesis and puts out the Sinhala text and speech according to the template. If the frame does not match with the template it returns to first level and get the next frame, processing one frame at one time. After noise removing, it makes a pattern (contour) around the hand gesture joining all vertices using Open-CV library. Background is converted to black colour and the contour area is converted to white colour which is called the filtered frame. Pyramid search is used to reduce the scale effect. Thus the main features of this system are to convert Sinhala sign language to Sinhala speech, Sign language learning tool, and displaying of converted signs as text.The prototype of the software system is successfully implemented using C#, Open CV (EMGU CV), and XML.

Main advantages of the system are that the possibility of real time identification, low cost as a web cam is the only additional hardware device needed and can use any Windows machine.

Supervisor : Mr. K. A. R. D. Gunaratne

Abstract No: EC210

Assessment of the Impact of Electric Vehicles on System Load Profile in Sri Lanka

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Electric vehicles are being promoted globally in recent years because of their potential to address energy security and environmental problems. Ever increasing environmental concern, potentially high petroleum prices, as well as uncertainty of future fossil resources enhance the electric vehicle penetration rates. Significant growth of Electric vehicles (EVs) sales has been observed in the recent years and it is not clear how the existing power system will support the challenging demand of power and energy for charging associated battery capacity.

The charging of great numbers of electric vehicles will definitely bring an impact on transmission and distribution of the power system. Due to the stochastic nature of EV's charging behavior, it affects significantly the demand during peak period of the power system which will lead to reduce system reliability, capability and operating efficiency.

In this study, the electric vehicles charging modes and main types of EVs in the industry have been considered. In order to evaluate the impact of variable factors on the aggregated EV load and associated charging characteristic, a model has been established to capture the relationship between the charging load and important factors based on data mining. The factors can be categorized as internal and external. The internal factors include the EV battery sizes, charging rate at different places of the chronological load profile, penetration of the charging infrastructure, and charging habits. The external factor is the time-of-use pricing (TOU) policy.

The study proposes a methodology which allows determining the aggregated EV charging demand. The model simulates each EV driver to consider its EV model characteristics, and charging processes required to reach its destination. Owing to its probabilistic nature, randomness of the variables such as number of electric vehicles, plug in time and battery charge duration are being carefully considered in this study.

Combining the probability distribution curves of the aforementioned variables, number of Electric Vehicles charging demand curves have been established and subsequently the charging demand curves are superimposed to the system load profile.

In view of the facts however limited, considered in this project, it can be concluded that the proposed methodology gives an idea of the impact of EV load on the system load profile. Since the penetration of Electric Vehicles to Sri Lanka transportation sector is just started, accuracy of the outcome of this study is highly dependent on the consistency of data considered where some of them are yet to be confirmed from the relevant institutions.

Supervisor: Eng. L. A. Samaliarachchi

Abstract No: EC211

Capacity Enhancement & Net Metering Study for Micro Hydro Power Plant at Demodara Tea Estate

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Hydro power is the most important and widely used renewable source of energy. Hydro electricity generation plays a major role in power generation in Sri Lanka and around 30 percent of country's electricity requirement can be supplied from the hydro power industry. From which 3.5% of demand is supplied by undispatcheple mini hydro power plants. This group project based on exciting run of river type micro hydro power plant installed at Demodara which is more than 75 years of age. Its maximum generation capacity is 66kW and it is being used by the tea factory.

In the case of capacity enhancement study for existing micro hydro power plant, the drawbacks/limitations of the existing structure of the micro hydro power plant is being identified. Also the appropriate/suitable size and locations for the basic structure of enhanced power plant is established. Design flow rate is one of the major considerations when designing a hydro power plant generation capacity. Considering flow rate data at Demodara gauging station and the geographical map of the Demodara area, design flow rate for the new enhanced power plant is selected as $2m^3/s$. Civil structure designs and electrical components selection of enhanced power plant have been done according to the design flow rate. It has been found that the maximum generation capacity is around 250kW which can be directly fed to national grid. Since the enhanced capacity is lies within the range of mini hydro power plant, this micro hydro power plant can be converted to a mini hydro power plant with capacity of 250kW.

In the case of net metering study, tea factory real energy consumption is compared with expected generation of enhanced hydro power plant. From which, it is identified most of the time imported energy to CEB side is much higher than that of the factory requirement. Therefore, flow rate of $1.7m^3/s$ is selected as the most feasible capacity of the power plant for net metering concept. Also it has been identified that the existing main panel is incapable of handling the excess energy for factory utilization. Therefore, net metering concept to the tea factory is recommended with the limited capacity of 200kW with improved main panel and sub panel designs.

A comprehensive techno-economic feasibility study has been carried out at the final phase of the project for two different capacities.

Supervisor/s: Eng. L. A. Samaliarachchi and Eng. (Mrs.) R. H. G. Sasikala

Abstract No: EC212

Supervisory Protective and Data Acquisition (SPADA) System to minimize the Electricity Forced Outage Time in Colombo North

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Frequent low voltage (L.V) electricity forced outages, both major and minor are common in experience that Ceylon Electricity Board (CEB) and their consumers living in an around highly dense Colombo area face today. These forced outages are unavoidable owing to their nature of occurrence. Immediate attention and restoration is required within a short period of time which would reduce the prolonged power cuts.

This project is mainly focused on reducing such breakdown restoration time, by considering the existing breakdown rectifying procedure of CEB (Ceylon Electricity Board) and its drawbacks. The objective of the project is to implement a new system of breakdown monitoring, reporting and equipment protection procedure to address the prevailing issues. Following drawbacks of the existing system have been identified during the literature survey:

CEB is not aware about any L.V. outages unless consumer informs.

In case of a L.V. outage, considerable time will be wasted to locate the place and fault.

Time wasted in identifying the failure (given that the location of outage is identified)

Absence of automated reporting/logging mechanism of outages and their history

Absence of a methodology to identify the over voltage situations and protect the equipment's of consumers from such situations in case of neutral wire disconnection.

The proposed system will consists of the following features:

- Electronic sensor circuits to identify the outages and over voltages.
- A central processing circuit to read the sensor inputs and transmit them via GSM modem.
- A controller circuit to handle the over voltage occurrences.
- A software module to read SMS input and locates the place with respect to a geographical map.

The said procedure helps to locate the breakdown and get the failure details very easily as the SMS contains most of the necessary information. Also this would prevent over voltage damages owing to the neutral isolation of the L.V distribution system. The software module and associated mobile application helps to navigate the location easily.

The proposed system gives the following advantages to CEB and their consumers living in Colombo north area.

- Less utility man power hours to locate and diagnose the fault.
- Save fuel cost associated with transportation for locating the breakdown.
- Reduce the breakdown restoration time.
- Save consumer's expenses from self-generation (if there is any).
- Reduction of unserved energy cost (ENS).
- Prevent damages of consumer equipment's from over voltage occurrences

Supervisor: Eng. L. A. Samaliarachchi

Abstract No: EC213

Frequency Controller Design for Kothmale Hydro Power Station using Fuzzy Logic

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The nominal value and the accepted tolerance of system frequency for Sri Lanka power system is 50± 1% Hz. Any mismatch between generation and demand causes the power system frequency to deviate from its nominal value. High frequency deviation may sometimes leads to system collapse. When a disturbance, be it a sudden load demand or a load shed in a power system occur, the speeds of the generating plants running in synchronism drops or it may gain speed & vice versa. Under the circumstances, the speed control mechanism of the turbine governors intervene and activate appropriately to maintain the rated speed of the generator thus reducing the system frequency error.

In Sri Lanka, the system frequency error is controlled by one of the selected power plant (one at a time) manually by plant operators. This is done by giving corresponding "lower" or "raise" command to the speed changing control gear of the turbine governor. However, when the disturbance varies dynamically operator is not in a position to give a fast quick response to maintain the system frequency at its nominal value. Hence, the system frequency always ends up with a steady state frequency error. If this error is not adjusted in timely manner, system frequency will have a steady state error right through out. This has been a major issue of concern to the system control center and to the power system operators at selected major hydro power plants as stated above such as Kothmale, Victoria, Laxapana, Samanala Wewa etc. Adjustment of steady state frequency error in the absence of secondary loop frequency controller at the said power stations is being the issue here owing to the imbalance of varying system supply and demand.

It has been well recognized in load-frequency (*pf*) analysis of power systems, to overcome this difficulty and to maintain the turbine speed at its rated value, a secondary loop control system to the main control loop should be introduced. This project goes one step further and considers the design and simulation of a fuzzy logic controller for one of the selected major hydro power plant i.e. at Kothmale, as a secondary loop automatic load frequency controller to smoothly eliminate the steady state system frequency error.

Project starts with the modelling and simulation of prevailing frequency control system using relevant parameters of Kothmale hydro power station and the chronological system load curve of Sri Lanka power system. MATLAB/Simulink software package is used to fine-tune and validate the said data to observe the steady state frequency error. Subsequently, a fuzzy logic controller has designed as a secondary loop of frequency controller and the study is repeated.

Fuzzy control provides a formal methodology of representing manipulating and implementing a human's heuristic knowledge about controlling a dynamic system. Mamdani type fuzzy inference system is employed here to implement this project because of it is simplicity, robustness, reliability and intuitive characteristics. Finally the simulation results with fuzzy logic controller is compared with the existing frequency controlling system of Kothmale hydro power station to prove that the FLC (Fuzzy logic controller) yields better control performance.

Supervisor: Eng. L. A. Samaliarachchi

Abstract No: EC214

Sri Lankan Currency Note Recognizer for Visually Impaired People

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In Sri Lanka, visual impairments affect a considerable percentage of population in various ways. Current estimates state that there are approximately 150,000 blind or partially visually impaired individuals in Sri Lanka. Visual impairments significantly affect the quality of life by limiting many day to day activities, specially handling money or financial transactions. Currently, the visually impaired communities rely on various traditional techniques to identify the different denomination of currencies which are not very effective. Moreover, Sri Lankan visually impaired people are facing a greater problem due to the introduction of the new bank note series, because the available features for blind people to identify the denomination are not very effective. There is only one feature which is a series of embossed dots that can be sensed by touch, available for visually impaired people to identify the denomination of various banknotes. But these dots are worn out after few usages. Also consecutive denominations only differ in 5mm from each other and also the difference is only in length. This 5mm length difference is not sensitive to visually impaired for identify various denominations of new currency notes.

Currently there is only one system that is catering for Sri Lankan currency identification whereas other systems are specially developed for United States and Canada. These foreign systems are based on charge coupled device / contact image sensor (CCD/CIS) technology while Sri Lankan system depends on dimensions and it is not portable. Therefore we propose an efficient, portable and a cost effective Sri Lankan bank note recognizer with a k-NN classifier. The proposed system detects the color (in R,G,B pattern) of the two edges of a banknote. Simultaneously the obtained data from two color sensors are classified using the k-Nearest Neighbor classification .The detection points are the edges of both sides and it lets the generated reference data sets be named as domains. There are 8 domains for each bank note denomination and 48(48 R,G,B data sets)domains for all 6 denominations(20,50,100,500,1000 and 5000 rupee). These are to be summarized and included in the program memory as the training set. According to the nearest neighbor method the Euclidean distance between the sensed parameters of the note to be recognized and the centroids of each domain are calculated and compared. The note is then classified under the domain corresponding to the least Euclidian distance. According to the test results, 48 bank notes were correctly recognized by the system out of 55 total bank notes. The system is currently having an accuracy of 87.27%. Also it was observed that the system is less capable of classifying the Rs.500 note which is erroneously classified to Rs.20. This inefficiency can be overcome by adding a color sensor to the system according to the method of k-NN classifier. Currently this is the best accuracy for a hand held Sri Lankan bank note classifier.

Supervisor: Eng. D. N. Balasuriya

Abstract No: EC215

A Study of the Green Aspects of Sri Lankan Mobile Communication Industry

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Worldwide mobile broadband communication networks will increasingly contributing to global energy consumption. 5G is the next step in the evolution of mobile communication. It will be a key component of a networked society as well as in “green communication”. 5G will provide wireless connectivity for a wide range of new applications and use cases including wearable technology, smart homes, smart city, traffic safety control and critical infrastructure. The design of 5G wireless systems should take into account minimizing the energy consumption in order to achieve greener wireless communication systems.

This research is to investigate what are the opportunities in moving to 5G in Sri Lanka and weaknesses of other technologies and also how 5G is deviated from these technologies. The main objective of this research is the identification of the acceptance of 5G in Sri Lanka and the factors which influence the willingness to adopt 5G. Energy consumption is currently one of the major concerns faced by the Government of Sri Lanka. Because of its significant environmental footprint and the eventual exhaustion, the major conventional energy sources are at a high risk. Green communications has received an adequate attention with the hope of inventing new solutions to improve energy efficiency, relieve, reduce radio pollution to unintended users and maintain, improve performance metrics. To obtain those benefits in Sri Lanka, the green communication industry should be more powerful. Therefore this research will be helpful to understand the acceptance levels of green communication. It also measures the willingness to move with 5G.

In this paper, power consumption, radiation, spectral efficiency and cost efficiency in wireless communication are studied. Questionnaires were given to many Network operators and based on the technical data and the manufacture products' details, total power consumption is calculated by considering the power requirement and the core network usage in 2G, 3G and 4G for a given number of subscribers and also per bit power consumption related to a base station.

Thereafter Radiation and Spectral efficiency are calculated for existing wireless technologies and measured the cost efficiency of a power equipment in a base station of 2G, 3G and 4G for maximum bit rate. Analyzed data will be compared with 2G, 3G and 4G wireless technologies and it will be shown that the desired improvement can be achieved in 5G without sacrificing the quality of the service.

Increasing energy cost makes a great impact on the telecom operator. This problem can be solved by improving the energy efficiency. From the case of study and the measurements it will be shown that the Base Station (BS) is the main equipment, which is responsible for energy consumption in a cellular network. Obtained results show that the 5G is the best wireless technology for power saving and other improvement in comparison.

Supervisor: Eng. D. N. Balasuriya

Abstract No: EC216

Electronic Honey Quality Analyzer

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Honey is a completely natural product produced by several sub species of bees. Although most of the commercially distributed honey has been subjected to some degree of processing, raw honey straight from the comb is highly valued. The quality of honey as a pure natural product is maintained by food regulations worldwide. Anything sold as honey has to have been produced by bees from the secretions of plants, and be free from additives and contaminants.

Nevertheless, the fraudulent practice of selling adulterated or simulated honey is widespread and has been going on since ancient times. To understand the challenge presented in detecting such fraud, it's necessary to be aware of the quality of honey.

Existing methodologies for honey analyses like liquid chromatography, isotope ratio mass spectrometry, multi component analysis are able to detect several such frauds. Most of these latest technologies are employed at the *Ayurvedic research center* as a regulatory authority to assure the quality of honey in Sri Lanka. But, most of these methodologies are very complex, that can be run only under specifically designed laboratory environments with the help of specially trained lab technicians and it's time consuming and very expensive. Due to these issues, some use conventional methods like honey-dip method to assure the quality of honey.

In this project a cost effective, high accuracy honey quality analyzer is developed, to replace the current complex, time consuming laboratory process and as a solution for honey adulteration in Sri Lanka. This analyzer is based on analytical methods to prove the quality of honey. Special emphasis has been put on combining available parameters for the honey quality detection, where parameters such as temperature, pH value, conductivity and reflective levels of honey are used in the classification. All these parameters were measured using sensor method and water content was measured using reflection method.

A joint classification with many parameters gives a promising approach to prove the quality of honey, especially when modern statistical data evaluation technique like neural network has been applied to the system. To increase accuracy, sample data is added to the neural network, which has been taken from the *Ayurvedic research center*. This data gives the qualities of proven references to the analyzer since these are the data already taken from various parts in Sri Lanka and has been categorized in to low and high quality. Honey quality analyzer displays the values of each parameter and ensures the Sri Lankan Standard (SLS) is met.

Honey quality analyzer is especially designed for bee honey industry in Sri Lanka and it ensures quality proven experience for honey buyers, honey suppliers, honey producers and for almost all the parties who are involved in bee honey industry In Sri Lanka.

Supervisor: Eng. D. N. Balasuriya

Abstract No: EC217

Development of an Optimized Indoor Positioning Algorithm under LTE Femtocell Coverage

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Satellite based Global Positioning Systems (GPS) have enabled a variety of location based services such as navigation systems, and become increasingly popular and important in our everyday life. However, in dense environments without clear sky visibility, GPS positioning may not be available and any localization techniques based on GPS would not be reliable. Mobile phone manufacturers and service providers are striving to introduce new features and services to their users. Among those emerging services, Location Based Services have obtained an increasing interest among mobile users and service providers. If it is possible to get alert of nearby coffee shop, stores, ATM machines etc., it would make day today life easier. Main objectives of the positioning researches are determining the position with least error and minimum calculations.

In this paper, indoor positioning for Long Term Evolution (LTE), femtocell cellular systems using Handover Ratios Matching (HOR) is studied. Generally, receiving signal strength (RSS) is adopted for the fingerprint method. For the proposed method, "**handover ratio"** is selected as the fingerprint variable.

It will be shown through computer simulations that the proposed positioning algorithm can significantly improve the positioning performance in LTE networks. Experiment results show that the proposed system out performs all other fingerprint based Reference Signal Receiving Power (RSRP) indoor positioning systems in the comparison, and is more accurate on average than existing methods.

Supervisor: Eng. D. N. Balasuriya

Abstract No: EC218

Voice Activated Home Automation System for Disabled People

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New technologies create new solutions for homes. The evolution and development in home automation is moving forward towards the future in creating the ideal home environment. There have been several commercial products and many use remote controls which have either buttons or fully touch screen. Still, monitoring and controlling the appliances need some movement and physical contact which could be a burden, especially for the disabled and elderly people.

In this project, a voice activated home automation system is proposed to support those who need special attention such as elderly persons, sick patients and disabled person through a system which operates via speech commands. The objective is to create a voice activated home automation system that uses biometric method such as human voice as a directive to activate electrical appliances.

The voice recognition is implemented using a neural network and Mel-frequency Cepstral Coefficients (MFCCs) and neural network tools. The voice commands will first be captured and pre-processed by Digital Signal Processing techniques and then output signal will be recognised using neural network concepts. After successful identification of the commands it will be fed to the microcontroller, which will activate the corresponding actuator. As a result, home appliances could be turned on or off depending on the voice command given. A prototype was successfully tested to verify the functionality using simple words in Sinhala language.

By further developing this project, people with disabilities can benefit and have convenience by lightening their burden. This makes their life easier so that they will not have to fully depend on other people.

Supervisor: Eng. (Mrs.) H. Pasqual

Abstract No: EC219

Smart Road Condition Checker

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This project addresses a common problem which we have to face when travelling in rural areas of the country. Even though the Google map provides information on finding unknown routes there is no source of information provided to know about the road conditions and their traffic status. State and Local maintenance departments are tasked with keeping roads in good repair, which includes monitoring the roads to detect the presence of cracks, potholes, and other distresses. Currently, this is done by inspectors, who drive out to each location and record the conditions on paper. This is a tedious and often inconsistent process. Using specialised vehicles outfitted with sensors can automate the data collection process significantly. However, these vehicles are expensive, costing as much as $500,000. Another way of collecting data is through citizen reports. But these are often only about severe and acute problems. In this project, we present a system to monitor the condition of roads on a continuous basis, at low cost, with consistent quality, and with minimal human intervention.

Here, there is an electronic device to be mounted in the vehicle with a vibration sensor and ultrasonic sensors that detect dampers and crack points of the road. When a vehicle with this device passes along a road it will get the current information of the road through these sensors and automatically updates this information to the Google map through a mobile application and a smart phone. The updated information will be helpful for the next vehicle to avoid using that road and can prevent the harm and time waste. For a successful implementation of this idea, the proposed system to be installed in commodity service vehicles such as cabs, garbage trucks, police cars etc. which already make regular rounds in specific areas.

With this system the whole street network of a city can be continuously monitored at a much lower initial and operating cost than traditional methods. Also it will help mostly drivers and other people who visit the country as tourists to get more benefits by avoiding roads with bad conditions. This will also help government as they can save the additional money which is to be paid for inspectors who check the road condition.

Supervisor: Eng. (Mrs.) H. Pasqual

Abstract No: EC220

Automatic Detection of Artificially Ripened Bananas

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In this highly competitive, globalised world, marketing has become a major concept for living. But today most marketers are trying to gain profits, without considering the quality of products especially how it could affect the consumers. In Sri Lanka this has become a major issue in food marketing especially for fruits.

Although ripening is a natural process, fruit sellers use chemicals to ripen them artificially for the purpose of reducing transportation and distribution problems. In the past, the use of calcium carbide for fruit ripening had been common. However, it has been banned in many countries as it is highly toxic, and is reported to cause various health hazards. Since then Ethephon has been used in Sri Lanka for artificial ripening of mostly bananas, papaw and mangoes. Ethephon (2 *chloroethylphosphoric acid*) when applied on fruits releases ethylene gas which helps to hasten ripening. Artificial ripening using chemicals is extremely hazardous to the human body. Though it is banned in many countries of the world, in Sri Lanka it is freely used. This project proposes the design of an electronic device which will automatically detect artificially ripened fruits and gives an indication about the concentration level of the applied chemicals.

The proposed device consists of three main parts, namely, detection unit, controller unit and the power supply. Here, the detection is done by measuring the conductivity of the water by which the banana is rinsed. In the detection unit, when a banana is inserted in the fruit holder and presses the start button, a sample of distilled water is inserted to the rinsing section by which the banana is washed out. Then the rinsed water is collected in the testing section where a conductivity sensor is fixed. A simple voltage divider circuit is used as the conductivity sensor. The output voltage is amplified and fed to the microcontroller. A reference curve is plotted for the output voltage vs conductivity (measured at the laboratory) and an equation of the curve is derived. Microcontroller uses this equation to calculate the relevant conductivity value for an unknown banana sample. This conductivity reading is compared with the threshold value by the microcontroller and the result is then transferred to the display. The threshold value is decided as 10µS/cm since the conductivity measured using the control sample is nearly 10µS/cm. The testing section is cleaned before testing another water sample. All these processes are automatically controlled by the microcontroller in the control section.

During the implementation of this project different types of artificially ripened banana samples were tested and results clearly showed that there are significant differences compared with bananas which were ripened naturally.

The proposed design provides the extensive technical support for early detection of artificially ripened banana at the market especially for food and consumer safety inspectors to carry out their duties efficiently.

Supervisor/s: Eng. (Mrs.) H. Pasqual and Dr.(Mrs.) B. C. Liyanage

Abstract No: EC221

Notes to Coins Exchanger

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Nowadays banks have enhanced many of their customer-facing, front-end operations with digital solutions. Online banking provides consumers enormous convenience and the rise of mobile payments is slowly eliminating the need for cash. Automation offers solutions that can reduce the back-office procedures from needless expense and errors.

Image processing has become an important incitement for increasing the degree of automation in production processes. It is now indispensable in quality control and product identification as well as in process management and monitoring. Only with the help of modern image processing systems is it possible to realize today's requirements in terms of traceability, quality, cycle time and safety. The idea of notes to coins exchanger based on image processing emerged due to above mentioned criteria. Major problem to be handled by implementing this system is to give a solution for the requirement of coins in day to day transactions at places like bus stations, railway stations and shops. Often people have to purchase things without rounded value therefore the necessity of various coins can be discerned. The major problem to be cope with this project is to make a convenient automated bank notes exchange system similar to the existing automatic teller machine. Mainly this system can be used to serve passengers, buyers who usually don't keep coins necessarily and this will make easier to transact with someone and this will save the passengers time as well as the service providers time and cease the problems due to this 'no change' issue.

This system comprise of following sub units. A notes inserting unit consists of one stepper motor, IR proximity sensor, UV ray sensor for fake note detection and HD camera and note collecting bin. A computer with Image acquiring and processing system which is based on accurate Matlab® algorithm and neural network based character recognition for identifying Sri Lankan bank notes. The coins dispensing unit which having four stepper motors for rotating a coin ejecting disks at a time and assuring precise coins ejecting process and four coins stacks for storing Rs.1, Rs.2, Rs.5,Rs10 coins. It also has a LCD display that informs the customers about the transaction process progress and DTMF keypad for acquiring information from the consumer.

Outlined operation of this system initiated with placing any Rs20, Rs50, Rs100 Sri Lankan bank notes properly in the note placing holder and then it will be subjected to a fake note checking process. After that image processing will be done in the same position and if the recognition process is success, denomination of the note will be send to the PIC microcontroller and dispense the particular amount of coins accordingly and prepare for the next transaction.

Supervisor: Eng. W. D. S. S. Bandara

Abstract No: EC222

Infant Smart Caring System

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When take care of a baby, crying in infants is common phenomenon and probably one of the most difficult problems parents have to face. Because the infant cry means the first verbal communication of new born baby with the world. Most times care takers advocates' strict routines to train the child into a regular feeding, waking and sleeping pattern without considering their emotional and physical needs. But leaving a distressed baby to cry on a regular basis could be damaging to the developing brain. Researchers have found babies whose cries are usually ignored will not develop healthy intellectual and social skills. But if we can take immediate action when the infant need attention, the learning and understanding process of the baby will be speeded up, and parents will have more time to enjoy their baby.

Currently, there are many types of baby monitoring systems including wearable devices, android applications, wirelessly controlled camera systems etc. Most of these systems are not sensitive and do not have the ability to detect the infant's cry. So the care takers need to be hearing all sounds of baby and most of these systems have ranges within a limited area. Due to this condition employed parents (especially mothers) cannot ensure the safety of their babies.

The aim of this project is to develop a portable, cost effective automatic infant's cry detector and self-soother with real time monitoring system for employed parents. An infant cry detection algorithm is used in this project. According to the algorithm, Infant cry signal is segmented by using short time energy function which is used as a voice activity detector to disabled the operation of the algorithm when voice activity was not present. Features are extracted using MFC (Mel frequency cepstrum) coefficients and pitch frequency over MATLAB (R2014b). Statistical properties are calculated for the extracted features of MFCC and pitch frequency and K-NN (k-nearest neighbor algorithm) classifier is used to classify the cry signal. With the help of proposed cry detection algorithm, it can easily identify the infant cry and it is verified by using K-NN with accurate results. Other than using only MFCC, the combination of Pitch and MFCC gives more promising approach to cry detection. Total average accuracy is 80.8335% in MATLAB simulation and on device shows 77.5% accuracy for cry detection.

On the other hand, because of immediate cry detection and self-soothing system baby's cognitive development process will be increase. This product is important to hearing impaired parents because the parent can get notification through android application which is password protected, and hearing impaired can configure their phone in to vibration mode when notification comes and can watch live video stream from baby's room. This all in one module approach gives great benefits to the first time parents/adoptive parents/care takers/researchers/physicians in both economically and scientifically as well as it brings social benefits.

Supervisor: Eng. D. S. Wickramasinghe

Abstract No: EC223

Hardware Platform for Home Automation (HomTo)

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The world is heading for connecting technologies. With the concept of IoT (Internet of Things) most of the physical devices will be connected with the internet. Smart homes or connected homes will be the future of home automation. With the upcoming energy crisis, home automation will play a major role in energy saving aspect as well. Even though, Home automation and connected home concept is new to Sri Lanka, with the technological trend, it is expected to establish those technologies in the Sri Lankan construction field.

The project is aiming to develop a hardware platform using the existing software platform and it is designed in a way that it will not affect the existing electrical wiring. This Product named as "HomTo". *HomTo* able to control and monitor selected appliances and lighting load in a house remotely. It can measure real time power consumption in whole and as individual appliances. These data can be logged for later analysis. House owner can analysis his energy consumption and track highest energy consumed time and appliance or as whole.

The system consists with three main boards. Namely, main controlling board, appliance controlling board and lighting controlling board. The main controlling board is linked to the main distribution panel. It measures total power consumption and it communicates with other two subs controlling boards to gather information about power consumption and it able to control all other sub modules via RF connections. Main board has the facility to connect to internet via Wi-Fi or standard Ethernet connection. Real time power measurement showed in an LCD display and detailed data can be viewed using the web portal. *HomTo* support popular Arduino software platform.

As a proof of concept, prototype has built and tested in the real environment.

Supervisor : Eng. D.S. Wickramasinghe

Abstract No: EC224

Electronic Differential for Rear Wheel Motor Driven Vehicle

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Electric vehicles are the latest trend in automobile industry. As per the decay of fossil fuel resources in the world, the automobile manufacturers attempted to manufacture electric vehicles. These are powered by internal battery and propulsion system is electric motor. Due to the rapid development of electronic systems, many electronic control systems were added in these vehicles such as automatic parking guidance, dynamic breaking and energy management. This area has rapid outcomes with new technology to market.

The differential is a device which splits the engine torque in to two ways, allowing each output which is driving each wheel, to rotate at a different speed. In a turn the inner wheel follows a shorter path than the outer one, hence required to be rotated at a lower speed. This component individually controls the outer and inner wheels of the vehicle and let the vehicle take a turn properly. Conventional differential is a mechanical component and this has been assembling in vehicles for decades. Still almost all the commercial vehicles employ the conventional mechanical differential. Electronic differential is an innovative concept in electric vehicle technology research areas. In here, wheels are powered by individual motors and the electronic controlling performs the functionality of the differential. There are many advantages by using an electronically controlled differential in a vehicle. It basically avoids the requirement of mechanical components in vehicle which would decrease the weight of the vehicle. By using individual controlling of wheels, the vehicle has more mobility options on drive.

This project is aimed to develop a control algorithm for an electronic differential. A mathematical model has been developed to formulate the input /output relationship of an electronic differential. Whereas the steering angle and the ratio of inner to outer wheel rotating speeds are considered as independent and dependent variables respectively. The model can dynamically provide the correct ratio of wheel speeds to the motor controller section of the vehicle.

Controllability is the key factor in order to select a motor type for electronic differential application. Therefore considering factors related to controllability and tractive effort, the design is done using DC motors. PWM method is used for motor controlling. Control scenario is evaluated with control systems applications as PID controllers. Overall design is simulated via Simulink® software and simulated parameters are used for prototype design. The proposed control algorithm is tested with a prototype model. Response of the system is tested in real time to evaluate the settling time and overshoot which are critical factors in real application. Test results prove, the model can provide correct speed ratio and the system is capable of making adjustments to the wheel speed accurately.

The intention is to provide basic model which could further developed to be utilized in industry. The model can be implemented with multithreading processors or multiple processors to obtain a smooth transition between speeds during the run.

Supervisor: Eng. I. A. Premaratne

Abstract No: EC225

Hybrid Powered Lighting for Foot Bicycles with Dynamic Braking

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Hybrid power describes the combination of two power sources and often will incorporate a storage system (battery, fuel cell). In power engineering, the term 'hybrid' describes a combined power and energy storage system. Many underdeveloped cities exist today in Sri Lanka. Most of the people in those cities use bicycles in their day to day life activities. Since some villages in Sri Lanka do not have street lights on footpaths and rural roads the people living in those villages have to use dynamo powered lighting for bicycles to see the road, obstacles and animals at night. Since the power output of the dynamo depends on the speed of the bicycle, this dynamo powered lighting system does not work when the bicycle is stationary. When the bicycle slows down the light output is reduced. Due to inadequate lighting many people face accidents on the road because they cannot see the obstacles. Therefore, in this project a system has been proposed as a solution for this problem.

This system can charge a battery in the normal run during day time operation and use this stored energy to power the lights even at zero speed. This system has an automatic battery charging system which uses voltage monitored State of charge tracking method, Dynamic braking for safe cycling and a constant voltage DC power supply for lighting and other requirements such as USB charging port.

This system has 6V, 12W hub dynamo and Ni-MH rechargeable battery pack. When the bicycle is stationary or moving at a slow speed the battery will produce the power to satisfy the electricity requirements of the bicycle. Therefore the power can always be kept constant. It has a DC to DC Step-up converter to convert the output voltage higher than the input voltage. Its output voltage is 12V. Due to low power consumption and long life time than incandescent bulbs, LED bicycle light is used for illumination. Also the USB phone charger system can be used whenever the cyclist needs to recharge a mobile phone or other smart electronic device while cycling.

The system can be further developed by manufacturing an application specified generator to replace the normal dynamo. A manual switch can be applied to cut out the dynamo supply to the system in an emergency or during hill climbing to reduce the effort on pedal.

Supervisor: Eng. I. A. Premaratne

Abstract No: EC226

Forward Collision Warning System for Light Vehicle

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Due to the increase of population the demand for goods and services goes high and people are struggling with time. Because of that the roads are crowded with vehicles. This causes increase of accidents. According to the statistics of type of accident and the number of occurrence, it is found that the number of "forward collision" happening is high. This can be avoided using a suitable type of warning system.

Forward collision problem was identified by most of the vehicle manufactures in late nineties. As results of research done on reasons for vehicle collisions, several systems such as adaptive cruise control have been introduce on modern vehicles. This option is available on luxury and semi luxury vehicles but not available on ordinary light vehicles. This project is aimed to give a solution to forward collision problem by introducing an alarm system for light vehicles which have no inbuilt adaptive cruise control system.

In this project, the distance measuring in a dynamic environment was the most important part. To avoid forward collision it is required to consider the vehicle stopping distance, breaking distance and driver reaction time. Getting distance information earliest as possible helps to minimize damage. The best solutions to scan longer distances with minimum time are LiDAR and RADAR systems. The RADAR sensor has more advantages than LiDAR such as higher update rate, performance of sensor and not degrading due to weather conditions or day/night condition. But the RADAR sensor is still expensive than the other competitors.

In order to analyze the probability of occurrence of forward collision while driving a vehicle, a mathematical model has been developed. The current speed of the vehicle, relative speed between succeeding vehicle and direction of driving – turning or changing lanes have been taken as independent variables to the model. The model can analyze the data and decide whether the vehicle is in danger of colliding with the front vehicle.

The mathematical model has been tested on MATLAB® by giving distance and turning angle data manually. The output of the model is the decision of whether the vehicle is in safe distance or not. Safe distance is calculated by considering the driver reaction time, specified by the National Highway Traffic Safety Administration (NHTSA) USA. The model successfully gave decisions on safe distance with given data.

The model has been implemented in real time. Distance sensors were used as inputs to the system. As future developments, more accurate and high range sensors can be used to suit the system for expressways which occupies very high speeds. Also it is recommended to formulate the driver reaction time and safe distance for Sri Lankan driving environment.

Supervisor: Eng. I. A. Premaratne

Abstract No: ME201

Copper Separation from Burned Out Charcoal-Copper Mixture

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Copper is one of the expensive materials in the world and also it has second highest electrical conductivity. Due to this reason copper is used as a conducting material in cable manufacturing. According to the standard, initially8mm diameter copper wire has to be produced and then small diameters of copper wires are produced by using die drafting process. Casting process is used to manufacture 8mm diameter copper wires.

Ceylon Copper (pvt) ltd is a company under ACL Cables group and produces 8mm diameter copper wires using upward die casting machine. In the process, copper sheets are melted in an induction furnace where the temperature reaches 1089°C. In order to avoid oxidization, a layer of wood charcoal is placed on top of the burning copper liquid. The burnt out charcoal ash has to be removed from the molten copper chamber from time to time and new charcoal has to be added. During ash removal process from the molten copper bath with the use of a stainless steel shovel, a certain amount of copper comes out with the burnt charcoal resulting in waste of copper which is not recovered.

The copper particles which come out with the ash mixture do not have regular shape and around 25% (by weight) of copper consist of the whole mixture. The company maintained around 4000kg of ash wastage mixture currently without a proper solution.

Therefore, the objective of the project was to find a solution to separate copper from the existing ash wastage. Various separation methods were analyzed and finally sieving method with a vibrating unit was designed and fabricated to solve the problem. Cam was used to generate vibration to the sieves. Main challenge was dust generation. To overcome dust generation, dust extraction unit was designed. At the fabrication process reusable material was used. Therefore overall fabrication cost was reduced. Sieving cage angle can be adjusted using square thread bar.

However, the machine would be helpful to the company for efficient copper recovering process.

Supervisor/s: Dr. H.D.Goonatilleke and Eng. P.R.Dadigamuwa

Abstract No: ME202

Semi – Automated Kottu Machine for Small Scale Ventures

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Food processing is one of the most sensitive and productive industries all over the world which directly affects the life and the health of the people. To reduce the risks in the industry international organizations have established certain standards in respect of equipment and accessories. In Sri Lanka, restaurants and fast food outlets have been one of the most forcing industries to be established after end of three decades of war; hence it is a timely requirement that hygienic issues are properly addressed.

Kottu is one of the frequently taken fast foods where it has been popular especially among the youth. The main problem associated with *kottu* preparation in local small scale hotels is the hygienically factors, where the chances of contaminations are high owing to the nature of the process. Also on the other hand *kottu* making stations are not properly designed and monitored which cause negative impact not only on the food but also on *kottu* maker's health. One way to ensure the hygiene conditions is to build-in the hygiene into the equipment used in the food manufacturing, where semi-automated *kottu* machine would be an acceptable solution. Therefore, this study was aimed to design such a machine for the use of small scale sellers.

The proposed machine has three major units namely, mixing and chopping unit, the heating element and rotating plate, and the depositary part. Mixing and chopping part being the imitation of existing manual process where it was mechanized with motor mechanism to achieve the desired motion. The heating element and rotating plate is the unit where all the required ingredients of *kottu* are deposited, mixed and cooked. The plate is rotated to get the good mixing and good heat spreading. Depositary unit is used to carry the required ingredients and subsequently to deposit them according to the sequence (oil, roti, vegetables and species). The Archimedean mechanism was used to deposit the ingredients where according to the number of revolution required amount of ingredients were moved forward and dropped into the base plate.

The main advantage of the machine is the less human intervention, which will ensure hygiene and also enhanced productivity.

Supervisor/s: Dr. Ruminda J. Wimalasiriand P. T. R. Dabare

Abstract No: ME203

Small Scale Chilli Cleaner

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Chilli powder industry is spread all over Sri Lanka. Not only large scale industries but also small and medium scale chilli powder makers are supporting to cater the demand of chilli powder based products in the local market.It is important to provide clean chilli products to the market. Small and medium scale chilli powder producersare using manual processes and the usage of machinery is limited. Cleaning process; removing the debris, stones and inedible partials, etc. also done manually. Some machines are available to increase the quality of the chilli, but these machines are expensive and cannot afford by the small and medium scale industry owners. This exercise is to fabricate a low cost machine to enhance the quality of chilly products in Sri Lankan market.

The available machines are based on different concepts to achieve required objectives; which involve rotation techniques, wind absorbent techniques and brushing methods. Considering the rotation and wind absorbent method both required covered and more secured housings and caused more air pollution. In this design vibration and brushing method is used considering the relative advantages and user convenient.

The proposed design consists of a vibrating unit and a brushing unit. Brushing unit is used to remove the surface dust of the chilli and the vibrating unit is used to separate the foreign particles which needed to be removed from chilli before further processing. The efficiency of the cleaning process was evaluated and it was found that the cleaned chilly is at an accepted level which further processing could be done. The quality of the chilly could be further improved by enhancing the brushing section, where the brushers should be design according to the requirement rather than using available brushers.

Supervisor/s: T. M. D .N. T. Medegedara and Ruminda J. Wimalasiri

Abstract No: ME204

Fault Diagnosing of Lakvijaya Power Plant: A Case Study of an Anti-Rotational Pin

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Phase 1 of the Lakvijaya power plant has suffered an inherent vibration problem leading to its temporary shutdown in 2013, 2014 and 2015. The main purpose of this study is to present a hypothesis to explain causes of these vibrations test the hypothesis and make suitable recommendations to avoid such occurrences in the future. When the shell of the bearing number 3 was opened for repairs in January 2015, it was observed that the anti-rotational pin of the labyrinth seal of the bearing has been broken causing the observed unusual vibrations. There are evidence to believe that this has happened in the two previous occasions as well. The shaft of the turbine is rested on eight bearings filled with pressurized oil and two labyrinth seals placed either side of each bearing prevent leaking of oil to the environment. When the shaft is rotating, usually at a speed of 3000 rpm, the oil layers adjacent to it also rotates with the same speed and this motion is transmitted to adjacent layers finally applying a tangential thrust on the labyrinth seals. Movement of the seal due to this thrust is prevented by an anti-rotational pin which is placed in a grove and rests against the wall of the grove. When the seal attempts move the wall of the grove applies a thrust on the pin causing it to deflect and hence the stresses on the pin get concentrated at two edges which are in contact with the wall. Periodic variation of the position of the shaft causes these stresses to fluctuate over a large range with the possibility of causing fatigue failure due to the repeated variation of stresses.

The project is aimed at testing the above hypothesis carrying appropriate computational modeling using Mathematical package and an Open Source Finite Element Software package "LISA".

Displacement of the shaft is usually expressed as peak to peak relative vibrations using proximity plots. In order to test the above hypothesis, various positions of the shaft revealed from the proximity plots were considered in both the x and y directions and the viscous drag on the labyrinth seal and thrust exerted by the wall of the grove on the pin were computed.

The stress distribution of the pin due to the deflection was computed using the finite element analysis method. In the analysis it was observed that the variation of the shaft position leads to a frequent variation of stresses to which the pin is subjected over a large range which leads to its fatigue failure.

A thorough investigation of the fracture surface one of the failed pins was also carried out. The visual inspections carried out revealed that fracture surface consist of breach marks. In order to obtain a better idea about the failure, several scanning electron microscope images of the pin were obtained. Analysis of the scanning electron microscopic images revealed that the fracture has propagated from the outer surface of the pin and propagated to final fracture by fatigue failure.

Another region of the scanning electron microscope image shows that the pin has been subjected to heavy deflection as well.

Supervisor/s:T.M.D.N.T. Medagedara and Ruminda J. Wimalasiri

Abstract No: ME205

Semi – Automated Cinnamon Bark Processing Machine

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Cinnamon is a valuable spice that is obtained from the bark of an evergreen tree (*Cinnamomumzeylanicum*) that belongs to the Laurel family. Cinnamon is native to Sri Lanka, Myanmar (Burma) and the southern coastal strip of India. It is well known that the best quality cinnamon is produced in Sri Lanka. Cinnamon bark is peeled off manually and the quality of cinnamon depends to a great extent on how well the bark is removed from the stems. The larger pieces or quills have a high demand compared the smaller broken pieces.

Many of problems in the cinnamon industry are related to the bark processing. Lack of skilled labour, labour cost and low product quality are the major drawbacks. Cinnamon being a product primarily for the export market, the quality is very important, as such highly valued higher grades should be processed for the sustainability of the industry. Processing usually accounts for about 60% of all the total production cost. Therefore, employment of trained and skilled peelers is essential to ensure high quality quills and that naturally increases the cost owing to high labour charges. A peeler can prepare about 2-3.5 kg of quills per day. Though, earnings of peelers are satisfactory at present, the labour shortage in the industry is also due to the reluctance of young to join the industry due to social recognition problems. The present problems can be addressed by introducing a semi-automated processing machine to ensure product quality as well as to increase the productivity, together with the work being perceived as respectable in the society. At present no such automated machine is available in the market and this study, therefore, was aimed at introducing a semi-automated cinnamon processing machine for the use of small scale production.

A complete design of the machine was carried out integrating main steps in the cinnamon bark removal process. The steps included scraping, rubbing and peeling off functions. The machine was designed to process specific sizes of cut cinnamon sticks such as 3”, 5”, and 7”. It primarily consisted of rotational and linear motion mechanisms and a tool changing mechanism. The entire system was motor driven (0.12kW) and tools were designed specifically to suit for uneven surface of the outer bark of the cinnamon sticks. A microcontroller based Arduino board was used to control the motors and other components. The machine was modeled and simulated using SolidWorks software and found to be functionally accurate. As a continued study, a prototype machine is to be built and tested.

Supervisor/s:Dr S. A. M. A. N. S. Senanayake and Eng. D. C. Wijewardane

Abstract No: ME206

Hand Gesture Controlled Robot Manipulator for Medical Applications

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Today we are living in a fast growing world of science and technology. We know at the beginning silicon revolution is followed by Moore's Law but today the growth has become exponential. Inventions in Mechatronics are the key factors in sophistication of industrial and domestic lifestyles. The applications invented by Mechatronics research are getting more popular and spreading all over the world. Robotics, Artificial Intelligence and Automation have become the backbone of the modern development and researchers are more willingly biased on solving real-world problems. Among them Robotics is one of the famous area of development and today more industrial and domestic applications are readily available. There are so many types of fixed and mobile robots. The main concentration of this project was the Robotics in medical applications. There are some robots which have been developed in the medical sector for various purposes. Hand gesture controlled robot manipulator for medical applications is a novel methodology of developing a medical robot. This project evaluates the effectiveness of master designs in bilateral systems for an epidemic environment and then identified the hand gesture vision attentive to be more effective. Therefore a system is designed to track and extract the position, orientation and the velocity of a fingertip using LMC (Leap Motion Controller) and then imitate in a 3DOF (Degree of Freedom) robot.

The mathematical model was developed for tracked fingertip position, robots kinematics (forward kinematics, inverse kinematics and joint space velocities), robot dynamics (joint torques by considering zero friction) and trajectory generation. The mathematical model was verified and analyzed using Mathematica 10 for all three joints for a particular case by plotting graphs of angle vs. time, velocity vs. time and acceleration vs. time. Then using MATLAB Robotics Tool Box 9.10 a real time simulation is developed by connecting to the LMC using matleap.

To develop this system as a standalone application, Processing (interactive programming) was introduced and AR (Augmented Reality) based user interface was developed to facilitate a convenient operation. The prototype was developed using MG 995 high speed robot servos and a vision camera. In the real time running we have experienced a little time delay and a less repeatability. Developing this system as an IoT (Internet of Things) device will be the further implementation of this project.

Supervisor/s: Ms. Nimali T. Medagedara, Mr. B. G. D. A. Madhusanka

Abstract No: TT201

Survey on Environmental Management System (EMS) to Reduce Carbon Footprint

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A proper Environmental Management System (EMS) and reducing Carbon footprint are interrelated and had become a global concern. Implementing such a system creates lot of opportunities and benefits to companies therefore managers are eager in develop proper EMS to reduce Carbon footprint over their products and services to increase efficiency, reduce waste, emission and to reduce the environmental risk; further this concept is assisted to make strategic plans for businesses by implementing cost reduction initiatives and carbon reduction programs to minimize the buyer's pressure and increase the profit of companies. Some Apparel manufacturers are developing this concept to build up the company image and to reduce waste.

Aim of this study is to provide guidelines and instructions for developing a proper environmental management system to reduce carbon footprint with the support of international standards. Interviewing technical experts in the sector using a structured questionnaire were used to collect data to identify the main principles behind this and introduce a method of streamlining the system. To develop a proper EMS and Carbon reduction methodologies, the researcher also studied the international standards; ISO 14001, ISO 14040, ISO 14069 and GHG protocol and other internationally accepted regulations. The main stages identified in developing the concept were based on ISO 14001 and commitment including establishing an environmental policy, implementation and evaluation. Before implementing the Carbon reduction methodologies, it was necessary to identify the possible methods and process controls. The study revealed that a need of a proper calculation methodology of Carbon footprint for the Sri Lanka textile industry companies.

The study revealed that there is a necessity of building a learning culture towards a proper EMS as the initial step, Thus it is required to make an awareness program in house about the carbon reduction methodologies before the implementation of the project, Then a challenging targets has to be set and analysis has to be done on material and energy transformations of the organization. Study also revealed on EMS and Carbon offsetting programs in Textile & Apparel industry the green building concept and eco-friendly architecture can increase the saving of energy and few companies has used and some others have suggested to incorporate the concept in their companies. Survey also highlighted that some have paid interest and involved in eco – friendly production methods and green culture was promoted. In the focus group discussions more managers were interested to involve more in green programs and encouraged to use latest techniques and developments such as to use electric cars and also other energy efficiency transport methods. As a result senior managers' owners had a tendency to increase funding and provide facilities towards green projects and more research into the area. The EMS and Carbon offsetting programs are added to the business plan could give long term benefits and long run maintenance will increase profits as well as protect the environment.

Supervisor: Mr. M. A. I. Perera

Abstract No: TT102

Beachwear Collection for Sri Lankan ladies

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Beachwear refers to clothing suitable for being worn on a beach and it's usually falls somewhere between swimwear and what a person wears when fully clothed. These clothes are wearing for many purposes such as swim, walking, relaxing and enjoy the surf and sand. Beach casual clothes are comprised in warmer temperature garments. These types of clothing are colorful, dries up fast, comfortable, simple and easy to clean and wear.

Beach wear collection was targeted to 21 – 29 age groups. Before design the collection beach wear requirements, colors, materials, accessories, evolution of beach wears, beach cultures have been studied .This collection designs for Sri Lankan ladies. Therefore it is important to discover Sri Lankan beach environment, Specialty and unique features of each beach, design requirements. After the above process identification and analysis of the target customers should be done. For that, an interview from 40 Sri Lankan ladies between 21 to 29 year ranges in Mount Lavonia, Wellawaththa areas was done. Then analyzes of the gathered information from the survey was conducted. According to the results of the survey, customers preferred for walking and relaxing event. Their spending power in-between LKR 1000 – 2000. They prefer for yellow and orange colors and selected silk and cotton materials. Their required lengths for garment are thigh, knee and ankle length. Selected sleeve types are sleeveless and cap. Selected necklines are off shoulder, strapped neck, V neckline, halter neck.

Inspiration for the design development is selected after the above process. It is the origin of designs and designs are sketched related to analyze the shapes, lines etc of the inspiration. Sunflower was selected as an inspiration and identified it different shapes, lines, colour range and developed the concept for the collection. This collection theme is "Flowing sun". Six (06) final outfits were selected out of range of sketches on collection of selected materials, colors, accessories and sketches. As well as finalize customer board, mood board, inspiration board, color palate and fabric board were designed. Final appearance of the collection is analysis through preparing sample outfits. Sample garments were made with sample fabrics, but use actual fabrics for final outfits. Difficulties and issues for final garment construction were identified through preparing sample garments. Photo-shoot and portfolio were prepared to present final outlook of the garment collection.

Supervisor: Ms . D. S. Wijerathne.

Abstract No: TT203

Design and Development of Office Wear Collection Inspired on Zebra Design

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This study is to design Office Wear Collection for employed young women who live in Western Province in Sri Lanka. The collection was designed inspired on Zebra design and the result of the trend and customer research, to get new countenance for office wears as slight tendency of changing.

Fashion is a distinctive and often habitual trend in the style in which a person dresses. It is the prevailing styles in behavior and the newest creations of textile designers. Fashion changes rapidly, based on the most recent fashion trends, especially of the West. In the current scenario, fashion industry, and to be more particular, the fashion apparel segment proves to be very volatile in nature. With new trends springing up every now and then. Clothing can be categorized as Casual wear, Resort wear, Office wear, Evening wear, etc. Each category of clothing changes according to seasons depending on the fashion trends. Office wears have different style rather than other categories. It does not mean leaving personal style behind. The goal to office wear is to project a professional, competent image, regardless of the employment level or career path. The styles, colors, lengths and fit of the fashion choices speak volumes about the ability to do a job.

In the study Office Wear Collection was named as “Genteel Shades of Colts.” The collection was designed inspired on Zebra design and the result of the trend and customer research, to get new countenance for office wears. The inspiration was gained through the behavior of human attitudes. Six costumes were developed using shapes of the Zebra, trend and customer research. The whole collection was designed in black and white. Cotton and polyester fabrics were used as raw materials and suitable trims were used to enhance the appearance of the designs. Comfort, durability, design, color, etc. were considered while designing the collection.

The office wear collection was done to get new countenance for work attires.

Supervisor: Mrs. D. S. Wijerathna

Abstract No: TT204

Bending Behavior of Polyester/Cotton Plain Fabrics with Plain Seams

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Fabric bending is one of the important properties for aesthetic performance of garments. It gives the elegant appearance for garments with providing drapability. But, seams, which are used to assemble the garment panels, can affect to change the fabric bending behavior and drapability of garments. Therefore, it is important to investigate how the various parameters related to the fabric, stitching, sewing and sewing thread effecting on the bending behavior of fabrics. In this research work, it was studied the effect of stitch density, seam allowance and size of the sewing thread on the bending behavior of polyester/cotton (65%:35%) industry used plain weave fabrics sewn with widely used stitch type (Lock stitch 301). For the experiments, three stitch densities (stitches/cm) such as 10(SD10), 12 (SD12)and 14(SD14) , three seam allowances such as 6mm(SA6), 10mm (SA10) and 14mm (SA14) and two sewing thread sizes having 75and 120 ticket numbers have used. Samples cut in warp and weft directions of the fabrics. Experiments were carried out using a standard fabric stiffness tester according to the ASTM 1388 – 96.

According to figure 1 and 2, stiffness of fabric samples have significantly increased after applying a seam(bending length of unsewn samples as 1.99cm and 1.71 in warp and weft directions respectively). Figure 1 shows that stitch density gives a positive correlation to fabric stiffness. Thus, seam allowance also gives a positive correlation to fabric stiffness, but stiffness reduced with SA14 with reference to each stitch density value used. This may be due to the higher fabric weight of SA14. Then, the fabric stiffness of plain seamed samples is higher in warp direction samples than weft direction sample. This is because of higher warp density of fabrics (57 warps/cm) than its weft density (27 wefts/cm).

Figure 2 also shows that stitch density and seam allowance (only for SA6 and SA10) give positive correlation to the fabric stiffness. But, lower fabric stiffness has given with SA14. It also reveals that the higher fabric stiffness in warp direction samples than weft direction samples. This may be due to higher warp densities of the fabric. Thus, by comparing the results, it is very clearly shown that stiffness of fabric samples increases, when they are sewn with the sewing threads having lower ticket numbers. Because, lower ticket number sewing threads are thicker and they are stiffer. They can add more stiffness to the sewn area of garment panels.

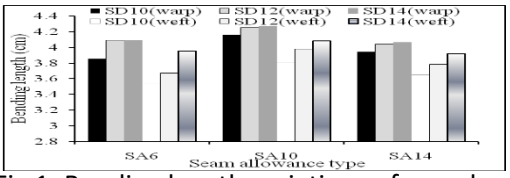

Fig 1: Bending length variations of samples sewn with 75 ticket number sewing thread

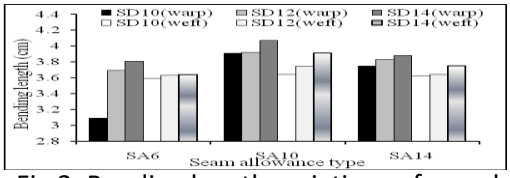

Fig.2: Bending length variations of samples sewn with 120 ticket number sewing thread

Supervisor: Dr C. N. Herath

Abstract No: TT205

Study into the Process of Effluent Treatment Used by the Handloom Manufacture in Sri Lanka

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This study is about the effluent treatment of waste water of Handloom industry in Sri Lanka. Most of the manufacturers are not doing the waste water treatment because of several reasons. However, it has become a major problem for environment balance. Manufacturers are releasing the water to rivers, lakes and land without doing any treatment for effluent. Therefore, it causes several hazards for the environment conditions, such as animal and human are affected from the toxic materials and pH value have negative effect to soil.

Before doing the waste water treatment they should be aware of certain information including the standard testing method that used by environmentalists. Those essential test methods are Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and pH of the effluent water. For these testing, there are manufacturing SLS standard. According to the results basically handloom waste water contains higher concentration of contaminants and toxic materials. These chemicals and dye particles will pollute the streams, rivers and soil.

There are two different geographical areas were selected in Sri Lanka for the study. It shows the effluent affect negatively giving several hazardous such as toxic organic materials in water. One place is “Hanwella” handloom plant and the other one is “Divulapitiya” plants. First observed the procedure they carry out and special ingredient and the dosages. All the tests that mentioned above are done for these two places, then compared their content and analyzed what of hazards being around them.

Finally from the analyses collected average values obtained are; COD is 857 mg/l and 1439 mg/l, BOD is 75 mg/l and 80 mg/l and average pH value of the effluent is 9.8 and 11. According to the SLS standard COD value should be 250 mg/l, BOD value should be 60 mg/l and pH value should be 6.5- 8.5 range. When we compare the values obtain by the study is adequated higher that the accepted COD, BOD and pH values.

Based on analyzed test results of BOD, COD and pH show imbalance and toxic nature to the environment. Release without proper treatment of the waste liquor to the land or to the aquatic system. Therefore, manufacture must take care to be maintain the accepted range by doing proper effluent treatment.

Supervisor: Mr. M. A. I. Perera

Abstract No: TT206

A study on the Influence of Washing and Hot pressing on the Colour Fastness of White School Uniform Materials

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White school uniform materials can become yellowish in short period of usage due to continuous washing and ironing. If a school uniform is washed twice in the week, it will be washed 96 times per year. This yellowing is a huge problem for the users and the parents of the users. This yellowing affects the appearance of the garments severely. Colour fastness to washing and hot pressing is the common quality parameter, which is considered very important from the point of view of consumers.

The objective of this study is to determine the effect of washing and hot pressing on the colour fastness of the white school uniform materials. Two different test procedures were carried out to determine the effect of the above mentioned two factors.

The standard ISO 105 C06 - colour fastness to domestic and commercial laundering was selected to determine the effect of washing of colour fastness. This test determines the loss & change of colour in the washing process. The samples were prepared as per instruction given. Three different types of widely used detergent types were used. In addition to that the testing was carried out with the neutral water for the comparison purpose. The tests were carried out for twenty washing cycles and the outcome was evaluated. The evaluation was done by using the ΔE values obtained after the each washing cycle. The changes in colour of the specimen were assessed by using the ΔE values obtained from the Data colour machine 600. It was observed that there are significant differences in the obtained ΔE values for three different detergent types selected for the test.

To find out the influence of the hot pressing on the colour fastness of white uniform materials, the standard test method ISO105-A02 was selected. The hot pressing was carried out as per the procedure mentioned in the standard. The color change was measured after each and every cycle of hot pressing. The total number of pressing cycles tested was 20. The changes in colour of the specimen were assessed by using the ΔE values obtained from the Data colour machine 600. It was observed that there is a significant change in ΔE values with the increase of the pressing cycles.

Supervisor: Dr. M. E. R. Perera

Abstract No: TT207

A study on the Factors Affecting the Occupational Stress of Sewing Machine Operators in the Factory ABC

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Stress is an unavoidable factor in the working life. The term stress can be defined differently. The literature of the stress emphasized that stress cannot be defined by a simple manner. When performing the tasks and responsibilities at the working place, the workers are subjected to stress due to numerous reasons. The apparel industry is a labour intensive industry and the above mentioned statement is valid for that industry as well. The garment manufacturing is performed in the sewing floor and the labour involvement in the sewing floor is very high compared to the other sections of the garment manufacturing process.

To perform this research study, a sewing floor of a reputed garment factory was selected. The main objective of this research is to identify the factors, which lead to the stress of the sewing machine operators and to suggest the possible solutions to minimize the possible causes.

A comprehensive literature survey was carried out to find out the major reasons for the stress at the selected factory. Total possible factors were categorized in to four subcategories such as work related factors at work place, human related factors at work place, environmental related factors at work place and external factors. Under each sub-category, most influential seven factors were selected for the study. By using the identified factors, a well organized questionnaire was designed to collect the primary data. The questionnaire consists of 28 questions. The Likert scale was used to obtain the responses for each and every question. A pilot run was performed with the help of 15 sewing machine operators and the designed questionnaire was improved with the gained experience and the information. The improved questionnaire was distributed among 200 sewing machine operators of the selected garment factory. The total number of sewing machine operators of the factory was 923. For the selection of the sewing machine operators, simple random sampling technique was used.

The collected data was analyzed in order to determine the level of relationship with the researched stress factors. The software packages Microsoft 2010, Minitab version 15 and SPSS version 16 were used to identify the possible relationships. For the analysis, different statistical techniques were also used.

Supervisor: Mr M. E. R. Perera

Abstract No: TT208

Composites from Fibres Extracted from Roots of Pandanus Tectorius

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Pandanus tectorius is one of the species of genus called pandanus .Monocot is the class and pandanaceae is family of this plant. Male plant is palm-like, dioecious trees and female plant like shrubs and native to the Old World tropics and subtropics. The plant grows from sea level to 610 m and mostly spread on exposed coastal headlands, along beaches and marsh region. The prop roots of this plant emerge from the stem usually grow towards the ground. The root as anchors in loose sand and keep the plant upright and secure them to the ground. Mature prop roots grow more than 50cm.Length of the root is depending on height of plants. When the plant become taller, all roots try to grow towards the ground .Usually prop roots have even diameter about 90% length of root from stem of plant. This plant is one of mangrove plant.

These Fibres are root fibres, but we can categorize these fibres as a candidate of bastfibre family. Because of Fibres are in core and bast of root. Pandanus root consist four fibre types. Such as mature bastfibre, immature bastfibre, immature vascular tissue fibre and Vascular bundle fibre. Fibre categorization based on properties and location of fibres in the root. Immature vascular tissue fibre, Mature and Immature bastfibres can extract by stagnant water retting, slow moving water retting and heating with different Noah %, time and temperature. Vascular bundle fibre can extract only by Dew retting. In the present work studied the microscopic view, length, diameter, Tensile Strength and Moisture Regain of each type of Pandanus root fibres under ISO 139 Textile standard atmosphere for conditioning and testing (AMENDMENT 1) Properties of each types of fibres state according to this order. Range and average fibre length, range of fibre diameter, tensile strength and moisture regain. Properties of Mature bastfibre are 19.5-141.2 cm, 53.8cm, 60-210 µm, 9.508 PI and 2.225%. Properties of Immature bastfibre are 3.7-160.1 cm, 18.2 cm, 40-140 µm, 3.907 PI and 6.320%. Properties of Vascular bundle fibre are 10.4-37.6 cm, 12.9 cm, 40-170 µm, 1.809 PI and 8.165%. Properties of Immature Vascular tissue fibre are1.5-9 cm, 5.4 cm, 20-120 µm, 4.198 PI and 8.782% .

Composite Developed by using phenol formaldehyde as resin and mature Bastfibres as textile fibre perform. Fibres cut to 4cm and fibres arrange in random orientation and 115 x 110 x 4 mm of composite made by Compression Molding Techniques. Develop different composite by changing weight of fibre content, such as 2.5g, 5g, 7.5g, 10g, 12.5g and 15g.Under ISO 37:2005 (Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties) standard, examine behavior of tensile strength at break , elongation at break and Young's modulus of each composites .

Supervisor : Dr M. A. I. Perera